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# MONTANA ENERGY POSITION PAPER
# A MONTANA ENERGY ADVISORY COUNCIL STAFF REPORT

*Prepared By*

THEODORE H. CLACK, JR.

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*Prepared By*

THEODORE H. CLACK, JR.

**June 1976**

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MONTANA ENERGY ADVISORY COUNCIL
STATE CAPITOL
HELENA, MT 59601

BILL CHRISTIANSEN, CHAIRMAN

June, 1976

The Honorable Thomas L. Judge, Governor
Members of the Legislative Assembly
The People of Montana

The Montana Energy Advisory Council (MEAC) herewith submits MONTANA ENERGY POSITION PAPER, a Montana Energy Advisory Council Staff Report.

House Bill 453 (Ch. 517, L. 1975) directed the Governor to prepare and submit "directly to the next legislature a long-term, comprehensive state energy conversion policy and plan including but not limited to alternative long-term growth goals, a statewide siting inventory and a proposed siting policy for the coordinated siting of energy conversion facilities to meet Montana's energy needs".

Governor Judge assigned these tasks to the Montana Energy Advisory Council. In sorting out these responsibilities and assigning portions of them to the appropriate agencies of state government, I concluded that specific recommendations for future energy conversion facilities should properly await the development of a state energy policy.

The MONTANA ENERGY POSITION PAPER was prepared by Theodore H. Clack, Jr., MEAC Staff Coordinator. It is **not** a state energy policy. Rather, it distills information from a variety of sources on Montana's energy situation, identifies the issues and impacts of energy development in the state and suggests a number of options the state should examine.

This document is being published in the fervent hope that it will be carefully read and seriously considered. Such a review, by the citizens of Montana and by state government, should enable MEAC to formulate a comprehensive and coherent state energy policy.

Respectfully submitted,

Bill Christiansen

Bill Christiansen
Lieutenant Governor

# ACKNOWLEDGMENT

For materials and suggestions used in this paper, I wish to thank Kye Cochran of the Alternative Energy Resources Organization; John Reuss and Richard Bourke of the Montana Environmental Quality Council; and Raymond Gold, Clancy Gordon, John McBride, Paul Polzin and Alice Sterling of the University of Montana. For invaluable assistance in editing various drafts of this paper, I wish to thank Joe Angell, Richard Bourke, Theresa Cohea, John Fitzpatrick, Richard Hargesheimer, John Reuss and Terry Wheeling.

# EXECUTIVE SUMMARY

## I. Introduction

Montana, underlain by immense quantities of easily strippable, low sulfur coal, is perceived as a source of fuel by a highly energy-consumptive and energy-dependent nation. Other sources of fuel are far less accessible to the nation. In addition, Montana is confronted by an impending shortage of natural gas, upon which many sectors of the state's economy are dependent.

The techniques by which the coal is to be developed and converted to more usable forms of energy, and the side effects associated with these techniques, are potentially destructive of essential social, economic and natural systems. Few definitive analyses of the effects, costs and benefits, in both short- and long-term contexts, of such energy development activities have been completed. Despite these gaps in our knowledge, plans are being made to develop Montana's, and the region's, energy resources and perhaps to convert them on site.

Decisions made in the next few years will have pervasive and long-lasting local and national effects. The magnitude of proposed solutions to the nation's energy crisis cannot fail to have profound effects upon our economies, our life styles and upon the natural and human resources upon which all of us depend.

At present, no coherent energy policy and development guidelines exist on the national, regional or state level. Montana has been blessed by the enactment of some excellent laws governing the development and use of energy resources within the state. These laws were prepared without the benefit of a commonly accepted, empirically-based policy regarding energy resources. These laws are not reflected by comparable statutes at the national level. Nor do they apply to all the questions that must be addressed if energy resource development is to proceed to the long-term benefit of the state.

The state must address these questions, must determine the extent of its natural and human resources, and must determine the interactions and inter-dependencies that exist between those resources. State government also must assess its statutory and administrative resources and responsibilities. Where gaps in our knowledge and resources are noted, they must be defined and recommendations to correct them must be generated. Given such analyses, the state then must develop policies and programs to ensure that energy development is conducted in the best interests of present and future Montanans.

## II. Energy Reserves, Production and Consumption

This chapter presents data on the extent of oil, natural gas and coal reserves in Montana and on hydroelectric capacity. Brief discussions of uranium development activity and of renewable energy resources also are included. Data on energy consumption, by source and sector, also are presented. Sources and amounts of imported oil and natural gas are identified. Finally, an energy flow chart for Montana is included.

Data on oil and natural gas reserves indicate that these fossil fuel reserves are near depletion in Montana. At current production levels, Montana oil reserves may be depleted within six years; known Montana natural gas reserves will be depleted in approximately twenty years. Montana coal reserves will sustain production for many years at current development levels.

*Recommendations:* The designation, staffing and funding of a Montana energy data office by state government is recommended. It is suggested that this office be located within the Governor's Office.

## III. Energy Development Projections

Two projections of energy development are presented in this chapter—that prepared by the Northern Great Plains Resource Program and that of the *Montana University Coal Demand Study*. These two projections are considered indicative of the range of development predictions that have been developed in recent years.

Of the two projections, the *Montana University Coal Demand Study* is the more sophisticated as it takes some development constraints into account. The Northern Great Plains Resource Program projection assumes that past energy consumption trends will continue into the future.

Montana coal production under the Northern Great Plains Resource Program projection is estimated to range from 58 million tons per year to 393 million tons per year by the year 2000. The Northern Great Plains Resource Program projected up to 17 new strip mines, 4 thermal electric plants and 7 gasification plants in Montana by that date.

The *Montana University Coal Demand Study* projects lower levels of coal production. Their analysis indicates that the market for Northern Great Plains coal is sensitive to air pollution control requirements and to various levels of growth in demand for electricity. Very large-scale development of Montana coal is considered unlikely unless demands for electricity remain high and production of synthetic fuels from coal is pursued. Montana coal production is estimated for each of several variations in national requirements for emission control and in national demand for electricity. Commercial generation of high BTU gas from coal is not considered likely due to price and technological constraints, according to the *Montana University Coal Demand Study*.

## IV. Constraints on Energy Development in Montana

**Natural Resource Constraints:** Most conventional energy reserves are finite and are approaching depletion. Other strategic raw materials are increasingly scarce. Water is the lifeblood of Montana and will be affected by energy development. Land disturbance will increase with energy development—reclamation potential becomes a significant question. The Montana outdoors will be adversely affected by most levels of energy development.

**Capital Constraints:** Energy development is highly capital-intensive—some development facilities cost billions of dollars. Demands for some forms of energy are declining and investment capital for some development activities is scarce. In addition, energy development will impose costs upon the government and commercial sectors which will require even more capital. Limited supplies of capital will slow both energy development and responses to its impacts.

**Manpower Constraints:** Construction of energy facilities will require highly skilled labor forces. The Federal Energy Administration Synfuels From Coal Task Force report indicates that shortages of skilled labor may inhibit energy development activities.

**Market Concerns:** The distance of Montana from major markets may limit large-scale energy development and derivative industrial growth. The market for Montana coal also will depend upon national energy demands and environmental standards. Large reserves of high quality coal exist in eastern areas of the United States—these reserves may be developed in preference to western coal under some conditions.

**Technological Constraints:** Some energy conversion technologies are still questionable in terms of energy efficiency, economic feasibility and commercial applicability. Site construction technologies for some processes also are uncertain. Nuclear technologies still are being scrutinized from the standpoints of safety and cost. Finally, technology has shown that some coals require custom engineering for proper burning. These constraints may influence the development of Montana coal.

**Policy and Law:** National laws and Montana statutes pose limits to energy development. These limits pertain to questions of environmental impacts and resource allocation. If energy development activities are in conflict with policies and law, they will be impeded or curtailed.

**Public Demand and Attitudes:** Public demands and attitudes will shape the nation's response to the energy crisis. As energy supplies become more expensive, demand may be expected to decline. Environmental, health and social costs of energy development also will affect public attitudes toward that development.

## V. Technological Alternatives Available to Montana

This chapter identifies the range of energy sources and technological alternatives available for consideration by Montana. Fossil fuel, nuclear, and renewable resource alternatives are identified and discussed. A number of suggestions is presented.

*Recommendations:* Minimum energy needs of the Montana economy should be determined. The state should determine the degree to which it can influence the development and use of energy reserves to meet state energy needs.

State energy conservation plans and programs should be developed for application at all levels. Statutory and policy impediments to conservation should be identified and remedied.

A thorough investigation of all synthetic fuels technologies should be undertaken by state government. At the same time, alternative mechanisms of supporting synfuels facilities should be examined, if such facilities are considered necessary in Montana.

The full range of alternative uses of coal as a substitute for oil and natural gas should be examined.

The state should become conversant with the costs, benefits and issues associated with the nuclear power controversy. Montana government also should become informed of likely sites of nuclear development in Montana.

State government should gather data relevant to the use of renewable energy resources and technologies. The data would be used to determine the feasibility of renewable energy in large- and small-scale applications.

State vovernment should expand its support of research and development of alternative energy technologies.

## VI. Some Effects of Energy Development

This chapter provides an introduction to some major effects of energy industrialization in Montana. Population, employment, school enrollment, housing demand, income and revenue projections are presented. These projections are drawn from a Northern Great Plains Resource Program report and from a publication of the Bureau of Business and Economic Research, University of Montana.

The effects of energy development upon groups, structures, organizations, government services and individuals also are presented. Discussion of these effects is drawn from research completed in Montana's energy development areas. In balance, the effects noted have been negative.

Finally, a range of possible environmental effects of energy development in Montana is discussed. Diverse native plant communities, ground and surface water, air, wildlife and land use will be affected by energy development. Significant air, water and noise pollution is anticipated.

## VII. Some Questions

This chapter discusses some vital and unanswered questions regarding energy development. These discussions address:

**Resource Allocation:** What is the proper use of the nation's remaining energy and materials reserves? The possible effects of certain resource allocation decisions

upon other resources—human and natural—are discussed. It is suggested that the optimum use of substantial portions of the nation's coal reserves may entail leaving them in the ground.

**The Montana Life Style:** The possible incompatibility of the Montana life style and energy development is addressed. The question of the degree to which concern for that life style will affect development of a state energy policy is raised. It is suggested that the possible conflict between the Montana life style and energy development be more thoroughly examined.

**The Role of the Public in Determining Montana Energy Policy:** The issue of public involvement in development of a Montana response to the energy crisis is raised. Suggestions are made regarding the necessity of public involvement and means of achieving it are briefly discussed.

**The Role of State Government in Determining Energy Development:** What are the alternative state government positions regarding energy development? It is suggested that Montana prepare an energy development policy to ensure that the state's needs are met. Possible conflicts between national energy plans and the needs of Montana are noted.

**The Nature and Duration of Energy Resource Development:** The possibility of a coal "boom and bust" if energy development is allowed to proceed without state guidance is discussed. The issues of growth in primary industry attracted by "cheap" energy and jobs for unemployed Montanans are considered. Potential incompatibilities between existing economic activities in Montana and energy development are examined briefly. It is suggested that Montana become conversant with the potential costs and benefits of energy development before irrevocable energy development decisions are made.

## VIII. A Montana Alternative

This chapter suggests the need for a formal state energy policy, what that policy should address and how it can be developed. A suggested interim energy development position is outlined.

An energy policy, subject to public review and input, is necessary to reduce confusion among the public and within government regarding the energy crisis. A policy statement can clearly identify the appropriate role Montana will play in resolving the energy crisis, and can clarify the responsibilities of various levels of government in meeting those roles. Policy also provides milestones against which progress can be measured.

State government is portrayed as the appropriate locus for development of a Montana energy policy. State government is more responsive to the needs of all sectors of the Montana public than is the federal government or the marketplace. The partisan political process cannot provide adequate time, resources and focus to properly develop a detailed energy policy.

The creation of a fully staffed and funded energy policy office is recommended. An outline of the issues an energy policy must examine is presented, as are the steps to be taken in developing the policy.

*Recommendations:* Finally, an interim energy position is presented. That position suggests that:

(1) Montana recognizes the existence of limits to economic growth and resource consumption, as traditionally defined. Recognizing these limits, Montana will discourage resource consumption based upon the assumption of unlimited growth and which limits the long-term quality or use of renewable and nonrenewable resources;

(2) Montana recognizes a policy of interdependence between states and nations. Montana resources will be developed in response to legitimate national needs and in compatibility with the needs of Montanans. Rapid and large-scale development of nonrenewable resources (particularly that apt to be of short duration) will be accepted only if no alternative is available and only if such development is conducted with due consideration for and correction of related resource costs. Development costs are to be borne by the consumers of the resource. State government will act to assure that such costs are met as equitably as possible;

(3) To the degree possible, the benefits of nonrenewable resource development will be invested in the maintenance and enhancement of the state's renewable resource base;

(4) Recognizing the relationship between population density and increased demands upon resources, services and the ecosystem, Montana will not encourage development activities which will entail any rapid and large-scale influx of people. In the event that some large-scale population influx becomes inevitable, the state will direct that influx to more urban areas, in preference to rural and agricultural areas;

(5) Construction of large-scale energy conversion facilities in Montana for export of energy products to other states will not be encouraged, unless no other alternatives exist. Only if such facilities are necessary to meet identified and defined Montana energy needs, will their construction be approved.

(6) Montana government will ensure that necessary energy resources are available to all Montana energy consumption sectors, consistent with good faith conservation efforts. To this end, state government will act immediately to determine the minimum levels of energy that are necessary to ensure the health of the citizenry and the state's economy. The state also will assess the administrative and jurisdictional resources available to this task and act to correct deficiencies. As an additional priority, the state will investigate existing and alternative energy production technologies that will serve to meet state energy needs. This investigation will focus upon readily available coal conversion technologies and will support the development and expansion of technologies to utilize renewable energy sources (*e.g.*, solar, biomass, wind and small-scale hydroelectric potential). Further, the state will accelerate the development of energy conservation

programs for both government operations and the state as a whole;

(7) Where investigations reveal the necessity of doing so, Montana government will prepare statutory proposals to cope with demands created by energy needs and energy development; and

(8) Montana State Government will adhere to a position of strict and conscientious enforcement of statutes and policies relevant to energy and natural resource development. The state will oppose vigorously any attempts by the federal government or other states to weaken or negate those statutes or policies.

# MONTANA ENERGY POSITION PAPER

## I. INTRODUCTION

Montana, underlain by immense quantities of easily strippable, low sulfur coal, is perceived as a source of fuel by a highly energy-consumptive and energy-dependent nation. Other sources of fuel are far less accessible to the nation. In addition, Montana is confronted by an immediate shortage of natural gas, upon which many sectors of the state's economy are dependent.

The techniques by which the coal is to be developed and converted to more usable forms of energy, and the side effects associated with these techniques, are potentially destructive of essential social, economic and natural systems. Few definitive analyses of the effects, costs and benefits, in both short- and long-term contexts, of such energy development activities have been completed. Despite these gaps in our knowledge, plans are being made to develop Montana's, and the region's, energy resources and perhaps to convert them on site.

Decisions made in the next few years will have pervasive and long-lasting local and national effects. The magnitude of proposed solutions to the nation's energy crisis cannot fail to have profound effects upon our economies, our life styles and upon the natural and human resources upon which all of us depend.

At present, no coherent energy policy and development guidelines exist on the national, regional or state level. Montana has been blessed by the enactment of some excellent laws governing the development and use of energy resources within the state. These laws were prepared without the benefit of a commonly accepted, empirically-based policy regarding energy resources. These laws are not reflected by comparable statutes at the national level. Nor do they apply to all the questions that must be addressed if energy resource development is to proceed to the long-term benefit of the state.

The state must address these questions, must determine the extent of its natural and human resources, and must determine the interactions and inter-dependencies that exist between those resources. State government also must assess its statutory and program resources and responsibilities. Where gaps in our knowledge and resources are noted, they must be defined and recommendations to correct them must be generated. Given such analysis, the state then must develop policies and programs to ensure that energy development is conducted in the best interests of present and future Montanans.

This paper has been written in an attempt to begin the analysis of the energy issue that must precede formulation of policy. In this context, issues and areas of information which must be addressed have been identified and briefly discussed. This paper is by no means meant to be definitive. It serves only to provide some basic information and to raise basic questions that should be addressed before serious policy decisions are made. The Montana Energy Advisory Council hopes that this paper will stimulate thought, discussion and the contribution of information from its readers. Future "editions" of this paper will address the information, questions and issues raised in more substantive detail.

## II. ENERGY RESERVES, PRODUCTION AND CONSUMPTION

Data and brief discussion of Montana's energy reserves, production and consumption are presented in this section.

### OIL

In Table II-1 is presented the December 1974 estimate of proven recoverable Montana oil reserves. Also included in this table is a ratio of the oil reserve to the current annual level of oil production. This figure may be used as a rough indicator of the length of time the proven reserve would sustain current levels of production. The term "proven reserve" indicates the amount of the remaining discovered resource that is considered feasibly recoverable in light of current market prices and technology.

**Table II-1**

**Proven Recoverable Montana Oil Reserves**
**December 1974**
**(millions of barrels)**

| Reserve | Reserve/Production |
|---|---|
| 207.4 | 6.0 |

**SOURCE:** *Energy Statistics, DOT-TSC-OST-75-33, August 1975.*

As indicated in Table II-1, Montana proven oil reserves will be exhausted in approximately six years, at current levels of production. Although a rise in the market price of oil (or an improvement in recovery technology) may serve to stimulate discovery of new proven reserves, the state does face exhaustion of its oil reserves in the very near future.

Data on recent levels of production of Montana's oil reserves are presented in Figure II-1.

As indicated in Figure II-1, the level of Montana oil production has been quite steady over the past five years. Aside from a 8.9 percent drop between 1970 and 1971, oil production has not varied substantially. The decrease in production between 1970 and 1972 is attributable largely to reductions in the Bell Creek and Williston Basin fields which, in 1973, accounted for nearly 70 percent of Montana oil production.

Oil refineries in Montana are a significant sector of the Montana economy. Data indicating average daily crude oil production of Montana reserves and average daily Montana refinery runs are presented in Table II-2. The data in Table II-3 indicate the sources of crude oil refined in Montana plants in 1973 and 1974. Note that Montana crude accounts for less than 20 percent of the oil refined in Montana plants in those years. Although most of Montana's refinery needs could be met by Montana crude for the next few years, much of the state's crude oil is exported. The state has no authority to determine the destination or use of developed oil reserves.

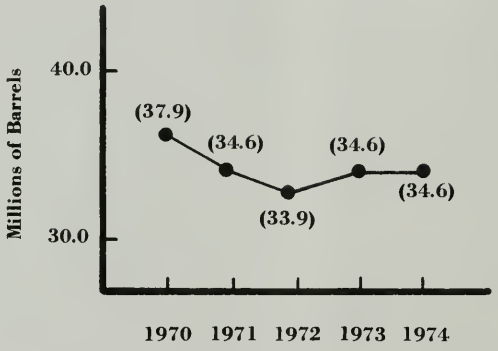



**Figure II-1: Montana Oil Production in Millions of Barrels, 1970-1974**

SOURCE: *Oil and Gas Energy Resources of Montana*, July 1974. Research report prepared for the Environmental Quality Council by Gustav Stoltz.

**TABLE II-2**
**Average Daily Crude Oil and Refinery Production in Montana, 1970-1974**
**(barrels per day)**

| | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|
| Total **Crude Oil Production** | 103,781 | 94,795 | 92,877 | 94,849 | 94,668 |
| **Total Refinery Production** | 115,973 | 123,288 | 132,767 | 139,636 | 131,651 |

SOURCE: *Annual Review For The Year 1974*, Vol. 18, Montana Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

## TABLE II-3

### Sources of Crude Oil Processed in Montana Refineries, 1973-1974

(average barrels per day)

| | 1973 | | 1974 | | 1975 | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ BPD | Percent | $\bar{X}$ BPD | Percent | $\bar{X}$ BPD | Percent |
| Montana Crude | 26,562 | 19.03 | 25,536 | 19.4 | 24,457 | 18.6 |
| Canadian Crude | 43,473 | 31.13 | 44,487 | 33.8 | 53,079 | 40.3 |
| Wyoming Crude | 69,599 | 49.84 | 61,627 | 46.8 | 54,241 | 41.1 |

**SOURCE:** *Montana Oil and Gas Statistical Bulletin.*

The significant dependency of Montana refineries upon Canadian crude is disturbing in light of Canadian intentions to eliminate exports of natural gas and petroleum to the United States. Initially, Canadian exports were to be terminated by 1983. Recent announcements indicate that these exports will be eliminated by 1981.

Data indicating Montana consumption of petroleum products, by sector, are presented in Table II-4. The units of energy consumed are expressed in trillions of BTUs (TBTU). One TBTU is approximately equivalent to 180,000 barrels of oil. All petroleum products, excluding natural gas, are subsumed under the heading of petroleum products in Table II-4.

## TABLE II-4

### Montana Consumption of Petroleum Products By Sector, 1970-1974

(in trillion BTUs)

| Sector | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|
| Electric Utility | 6.1 | 0.0 | 0.2 | 1.3 | 1.2 |
| Residential | 11.8 | 12.2 | 13.9 | 14.2 | 17.5 |
| Commercial | 1.6 | 1.5 | 1.8 | 1.8 | 2.2 |
| Industrial | 17.6 | 18.5 | 23.9 | 24.6 | 23.6* |
| Agricultural | 6.7 | 7.4 | 7.7 | 7.1 | 6.7 |
| Transportation | 55.7 | 58.7 | 62.2 | 68.5 | 65.7 |
| Totals | 93.5 | 98.3 | 109.7 | 117.5 | 116.9 |

*In each year, a significant percentage of consumption is of asphalt and road oil.

**SOURCE:** *FEA "Straw Man" Estimates: Annual State Energy Consumption,* Federal Energy Administration, Washington, D.C., September 1975.

Percentages of total state consumption of petroleum products by sector are presented in Table II-5. As would be expected, the transportation sector is the most significant consumer of petroleum products in Montana. The national proportion of total petroleum product consumption by the transportation sector was 24.7 percent in 1974. Montana's markedly higher consumption of petroleum products by the transportation sector may be explained by the greater distances to be traveled in the state and by the relatively minor consumption of petroleum products by the utility and industrial sectors.

TABLE II-5

Sector Consumption of Petroleum Products as a Percent of Total State Consumption

| Sector | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|
| Electric Utility | < 1.0 | 0.0 | < 1.0 | 1.1 | 1.0 |
| Residential | 12.6 | 12.4 | 12.7 | 12.1 | 15.0 |
| Commercial | 1.7 | 1.5 | 1.6 | 1.5 | 1.9 |
| Industrial | 18.8 | 18.8 | 21.8 | 20.9 | 20.2 |
| Agricultural | 7.2 | 7.5 | 7.0 | 6.0 | 5.7 |
| Transportation | 59.6 | 59.7 | 56.7 | 58.3 | 56.2 |

SOURCE: *FEA "Straw Man" Estimate: Annual State Energy Consumption*, Federal Energy Administration, Washington, D.C., Sept. 1975.

## NATURAL GAS

In Table II-6 is presented the December 1974 estimate of proven recoverable Montana natural gas reserves. Also included in this table is a ratio of the natural gas reserve to the current annual level of natural gas production. As above, this figure may be used as a rough indicator of the length of time the proven reserve would sustain current levels of production.

TABLE II-6

**Proven Recoverable Montana Natural Gas Reserves December 1974**
**(billions of cubic feet)***

| Reserves | Reserves/Production |
|---|---|
| 1,054** | 20.9 |

* These figures differ from those compiled by the Oil and Gas Conservation Division of the Department of Natural Resources. Their figures would be 901.3 and 17.7, respectively.

**In addition, there were 207 billion cubic feet of gas reserves in underground storage as of December 1974.

SOURCE: Personal communications with Richard Bourke, Montana Environmental Quality Council. His statements are based upon contacts with the Montana Power Company, Northern Natural Gas Company, Montana-Dakota Utilities, Kansas-Nebraska Natural Gas review of FPC Docket No. CP 73-340.

At current levels of production, Montana's proven gas reserves will be exhausted in about 20 years. Assuming that an increasing proportion of these reserves might be consumed in state and/or that production of gas will increase as Canadian imports are eliminated, the gas reserves are apt to be exhausted in less time. As in the case of oil, a rise in the market price of natural gas is likely to stimulate additional gas exploration and may result in an increase in the proven reserve. Even so, natural gas supplies are finite and are nearing exhaustion, here and elsewhere.

Data on recent levels of Montana natural gas production are presented in Figure II-2.

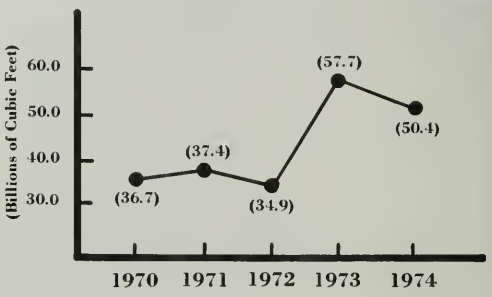



**Figure II-2: Montana Natural Gas Production, 1970-1974 (Billions of Cubic Feet)**

SOURCE: *Annual Review For the Year—1970-74*, Vols. 14-18, Montana Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

The sudden rise in gas production in 1973 is due to the Tiger Ridge field discovery and development. Although production was still markedly higher in 1974 than in 1972, production dropped nearly 13 percent between 1973 and 1974. Natural gas production in 1975 is expected to parallel that of 1974. Of the natural gas produced in Montana, nearly 30 billion cubic feet (just over 50 percent of total production) was exported in 1973; comparable figures for 1974 are nearly 17.5 billion cubic feet (34.7 percent of total production).

The sources of natural gas marketed in Montana are indicated in Table II-7. Both state suppliers of natural gas import that product to a substantial degree.

## TABLE II-7

### Sources of Natural Gas Marketed in Montana 1974

(billion cubic feet)

| Supplier | Volume | Percent Company Total | Percent Total Gas Marketed |
|---|---|---|---|
| Montana Power Company | | | |
| Montana Production | 10.44 | 17.8 | 12.9 |
| Imports (Canada) | 48.11 | 82.2 | 59.7 |
| Montana-Dakota Utilities | | | |
| Montana Production | 8.22 | 37.2 | 10.2 |
| Imports (Wyoming/Dakotas) | 13.85 | 62.8 | 17.2 |

**SOURCE:** Personal communications with William Opitz, Montana Public Service Commission.

Although both suppliers of natural gas in Montana are dependent upon imported natural gas, only the Montana Power Company (MPC) is threatened by a present severe curtailment of natural gas supplies and the termination of imports in the near future. The Montana Power Company supplied 66.9 percent of all natural gas consumed in Montana in 1974. The reduction and elimination of the Canadian supply of natural gas thus threatens nearly 55 percent of Montana's marketed natural gas supply.

Data expressing Montana consumption of natural gas, by consumption sector, are presented in Table II-8. The consumption of natural gas is expressed in trillions of BTUs (TBTU). One TBTU is approximately equal to one billion cubic feet of natural gas.

## TABLE II-8

### Montana Consumption of Natural Gas* By Sector, 1970-1974 (trillions of BTUs)

| Sector | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|
| Electric Utility | 2.6 | 1.1 | 1.3 | 2.4 | 2.3 |
| Residential | 25.6 | 26.2 | 24.5 | 25.4 | 25.5 |
| Commercial | 16.0 | 16.2 | 17.1 | 17.1 | 17.1 |
| Industrial | 37.3 | 38.0 | 34.3 | 38.7 | 38.3 |
| Agricultural | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Transportation | 0.7 | 0.8 | 1.1 | 1.7 | 1.5 |
| Totals | 82.2 | 82.3 | 78.3 | 85.3 | 84.7 |

* The total consumption figures do not coincide with data derived by the Department of Revenue from tax receipts. The data are presented for the purpose of allowing inter-sector comparisons.

**SOURCE:** *FEA "Straw Man" Estimates: Annual State Energy Consumption,* Federal Energy Administration, Washington, D.C., September 1975.

Percentages of total state consumption of natural gas by sector are presented in Table II-9. The industrial sector is the major consumer of natural gas in the state, followed by the residential sector (at about two-thirds industrial consumption).

TABLE II-9

Sector Consumption of Natural Gas As A Percent of Total State Consumption

| Sector | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|
| Electric Utility | 3.2 | 1.3 | 1.7 | 2.8 | 2.7 |
| Residential | 31.1 | 31.8 | 31.3 | 29.8 | 30.1 |
| Commercial | 19.5 | 19.7 | 21.8 | 20.0 | 20.2 |
| Industrial | 45.4 | 46.2 | 43.8 | 45.4 | 45.2 |
| Agricultural | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Transportation | <1.0 | <1.0 | 1.4 | 2.0 | 1.8 |

**SOURCE:** *FEA "Straw Man" Estimates: Annual State Energy Consumption*, Federal Energy Administration, Washington, D.C., September 1975.

Consumption of natural gas in Montana has been remarkably stable in the past five years, particularly in light of the low price of the product, a rate structure that encourages increased consumption of gas, and its great convenience. Although per capita use of natural gas in Montana is higher than the national average (due to our highly energy intensive industries), our rate of growth of consumption of gas is much lower than the national rate. Such stability in gas consumption is likely due, in part, to what some economists have called our "stagnant" economy.

To date, no curtailments of natural gas have been necessary in Montana, except in the interruptable industrial sector. The Canadian export policy is expected to change this situation. According to reports, no new residential hookups are being accepted by the Montana Power Company system. Industrial consumers of gas have been warned to expect gas curtailments of as high as 50 percent in the very near future. Recent negotiations with the Canadian government indicate that a longer-term gas export contract will be negotiated in mid-May, 1976. It is anticipated that 34.2 billion standard cubic feet may be available to Montana annually until 1983. Although this total is nearly 30 percent lower than previous total import levels, with conservation and conversion to other fuels, Montana's needs may be met without curtailments. The Governor's Gasification Task Force has estimated that some 10,000 jobs are associated with industries that now are dependent upon natural gas. The new gas leases acquired by the Montana Power Company are expected to meet no more than one year's demand on their gas system. In addition, there are, as yet, no gathering and distribution facilities on site to make that gas available.

## OIL AND NATURAL GAS DEVELOPMENT AND EXPLORATION ACTIVITY

In Table II-10 are presented data indicating oil and natural gas production, development and exploration activities in Montana since 1970. Increased gas development activity is generally attributed to discoveries in the Tiger Ridge and Bear Paw fields. The increase in oil-related development activity noted in 1974 and 1975 probably is attributable to higher prices brought by oil and gas. Increases in oil activities have been noted statewide, rather than exclusively in known fields.

## TABLE II-10

### Number of Producing Wells, Development Wells Drilled and Exploratory Wells Drilled, Montana, 1970-1975

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|---|---|
| No. of Producing Wells | 3,212 | 3,145 | 3,134 | 2,993 | 3,100 | 3,247* |
| Development Wells Drilled | | | | | | |
| Oil | 60 | 49 | 79 | 46 | 58 | 88** |
| Gas | 30 | 36 | 97 | 165 | 179 | 230** |
| Dry Holes | 63 | 34 | 87 | 100 | 212 | 206** |
| Totals | 153 | 119 | 263 | 311 | 449 | 524 |
| Exploratory Wells Drilled | | | | | | |
| Oil | 12 | 3 | 7 | 6 | 7 | 15** |
| Gas | 11 | 22 | 19 | 36 | 21 | 43** |
| Dry Holes | 272 | 323 | 435 | 366 | 265 | 316** |
| Totals | 295 | 348 | 461 | 408 | 293 | 374 |

* Estimate by the Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

**Estimates by Petroleum Information, Inc., Denver, Colorado. Personal communication with Judson Sweet, Montana Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

**SOURCE:** *Annual Review for the Year 1974*, Vol. 18, Montana Oil and Gas Conservation Division, Department of Natural Resources and Conservation.

**COAL**

Montana is underlain by massive amounts of coal. Recent communications of the Montana Bureau of Mines and Geology estimate the existence of 50 billion-plus tons of strippable lignite and subbituminous coal under overburden of 300 feet or less, in only a part of Eastern Montana. According to the Montana Bureau of Mines and Geology, the U.S. Geological Survey claims the existence of 107.7 billion tons of known and estimated coal reserves in Montana. These reserves are sufficient to last for hundreds of years at current levels of production.

Coal production in Montana has increased 400 percent since 1970. Consideration of current contracts and mine capacities indicates that nearly 43 million tons of coal may be mined in Montana by 1980, assuming construction of Colstrip Units III and IV and approval of planned expansions of the Decker mine.

Growth in Montana coal production is indicated in Figure II-3. This figure presents both actual production from 1970 to 1974, and estimates of production for 1975 through 1980.

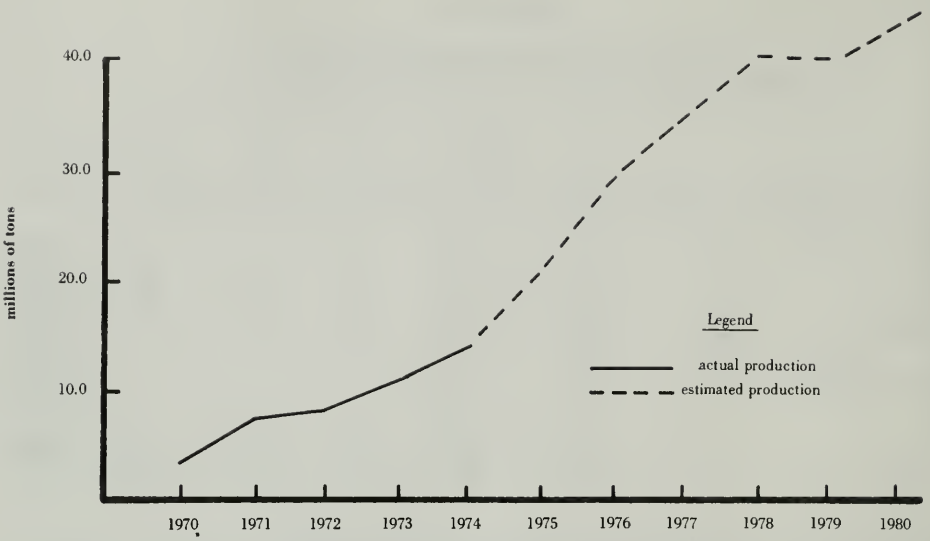



**Figure II-3: Actual and Estimated Coal Production in Montana, in Millions of Tons, 1970-1980.**

**SOURCE:** Data taken from *Coal Development Information Packet*, Montana Energy Advisory Council, December 1974.

Data presented in Table II-11 indicate estimated coal production by use for the years 1975 and 1980. These data clearly demonstrate that the major proportion of the coal produced in Montana is exported for use elsewhere.

**TABLE II-11**

**Estimated Coal Production by Use, Montana — 1975, 1980**
**(millions of tons)**

| Coal Use | 1975 | % Total | 1980 | % Total |
|---|---|---|---|---|
| Export | | | | |
| Western Energy | 4.33 | 20.8 | 10.00 | 23.4 |
| Decker Coal | 8.25 | 39.7 | 13.90 | 32.5 |
| Westmoreland | 4.00 | 19.2 | 6.50 | 15.2 |
| Peabody | 3.00 | 14.4 | 3.00 | 7.0 |
| Export Total | 19.58 | 94.1 | 33.40 | 78.0 |
| Electrical Generation | | | | |
| Sidney Plant | 0.32 | 1.5 | 0.32 | 1.0 |
| Corette Plant | 0.50 | 2.4 | 0.52 | 1.2 |
| Colstrip I & II | 0.40 | 1.9 | 3.00 | 7.0 |
| Colstrip III & IV | 0.00 | 0.0 | 5.60 | 13.1 |
| Elec. Gen Total | 1.22 | 5.9 | 9.42 | 22.0 |
| GRAND TOTAL | 20.80 | | 42.82 | |

**SOURCE:** Data taken from *Coal Development Information Packet*, Montana Energy Adivsory Council, December 1974.

The data in Table II-12 are presented to indicate the percent change of in-state use of coal if Colstrip Units III and IV are approved.

**TABLE II-12**

**Estimated Change of In-State Use of Coal, Montana — 1975, 1980**
**(millions of tons and percent)**

| 1975 | 1980 | | 1975-1980 |
|---|---|---|---|
| MM Tons Consumed In State | MM Tons Consumed In State | Change of In-State Consumption | Percent Change |
| 1.22 | 9.42 | 8.20 | +772 |

SOURCE: *Coal Development Information Packet*, Montana Energy Advisory Council, December 1974; Environmental Impact Statement prepared by the Department of Natural Resources and Conservation regarding proposed Colstrip Units III and IV.

## HYDROELECTRIC CAPACITY

Until 1975, Montana's installed hydroelectric capacity had been constant since 1972. A significant increase in hydro capacity will be noted when the Libby Dam facilities are completed. The Libby Dam facilities will contribute approximately 888 megawatts to the total hydro power capacity in the state if all authorized construction is funded. This addition will represent an increase of 61 percent in existing hydro capacity for a total of 2,347 megawatts. At present, four 105 megawatt units are in operation at Libby. The existing and proposed hydro facilities in Montana are identified in Table II-13.

**TABLE II-13**

**Hydroelectric Capacity in Montana**

| Existing Power Plants | Type | Owner | Year Of Completion | Name Plate Capacity (MW) | Location |
|---|---|---|---|---|---|
| 1. Madison | H | MPC | 1912 | 9.0 | Madison River |
| 2. Hauser | H | MPC | 1912 | 17.0 | Missouri River |
| 3. Holter | H | MPC | 1918 | 38.4 | Missouri River |
| 4. Black Eagle | H | MPC | 1929 | 16.8 | Missouri River |
| 5. Rainbow | H | MPC | 1929 | 35.6 | Missouri River |
| 6. Ryan | H | MPC | 1929 | 48.0 | Missouri River |
| 7. Morony | H | MPC | 1930 | 45.0 | Missouri River |
| 8. Cochrane | H | MPC | 1957 | 48.0 | Missouri River |
| 9. Mystic Lake | H | MPC | 1927 | 10.0 | West Rosebud Creek |
| 10. Flint Creek | H | MPC | 1935 | 1.0 | Flint Creek |
| 11. Milltown | H | MPC | 1929 | 3.0 | Clark Fork River |
| 12. Thompson Falls | H | MPC | 1929 | 30.0 | Clark Fork River |
| 13. Kerr | H | MPC | 1938 | 168.0 | Flathead River |
| 14. Noxon | H | WWP | 1960 | 230.0 | Clark Fork River |
| 15. Big Fork | H | PPL | 1930 | 4.26 | Swan Lake |
| 16. Fort Peck | H | CE | 1940 | 165.0 | Missouri River |
| 17. Canyon Ferry | H | BR | 1954 | 50.0 | Missouri River |
| 18. Hungry Horse | H | BR | 1953 | 285.0 | S. Fork Flathead River |

Table III-13 (Cont.)

| | | | | | |
|---|---|---|---|---|---|
| 19. Yellowtail | H | BR | 1966 | 250.0 | Bighorn River |
| 20. Big Creek | H | FIP | | 0.36 | Big Creek |
| 21. Troy | H | MLP | 1916 | 4.5 | Lake Creek |
| 22. Libby #1 | H | CE | 1975 | 105.0 | Kootenai River |
| 23. Libby #2 | H | CE | 1976 | 105.0 | Kootenai River |
| 24. Libby #3 | H | CE | 1976 | 105.0 | Kootenai River |
| 25. Libby #4 | H | CE | 1976 | 105.0 | Kootenai River |
| | | | | 1,878.92 | |
| **Total Existing Proposed Power Plants** | | | | | |
| Libby #5 | H | CE | 3/77 | 105.0 | Kootenai River |
| Libby #6 | H | CE | 6/77 | 105.0 | Kootenai River |
| Libby #7 | H | CE | 9/77 | 105.0 | Kootenai River |
| Libby #8 | H | CE | 12/77 | 105.0 | Kootenai River |
| Rereg. #1 | H | CE | 1/83 | 7.5 | Kootenai River |
| Rereg. #2 | H | CE | 4/83 | 12.8 | Kootenai River |
| Rereg. #3 | H | CE | 7/83 | 12.8 | Kootenai River |
| Rereg. #4 | H | CE | 9/83 | 12.8 | Kootenai River |
| TOTAL PLANNED AND EXISTING | | | | 2,344.82 | |

SOURCE: In-house documents, Montana Energy Advisory Council, and data from environmental impact statement prepared by the Department of Natural Resources and Conservation regarding proposed Colstrip Units III and IV.

## URANIUM

There have been no discoveries of commercial quality uranium ore in Montana. Adoption of solution mining techniques for development of uranium ores may change the definition of "commercial quality" ore. Should this occur, uranium deposits in Montana could be considered suitable for development. According to the Montana Bureau of Mines and Geology, likely areas for discovery of exploitable uranium ore in Montana lie within the Big Hole drainage, the Ruby Valley and the Carbon County quadrant in Eastern Montana. Some quantities of pitchblende have been noted in Northestern Montana near the Idaho border.

As of November 1975, the Montana Department of State Lands had received 45 applications for uranium prospecting permits. Forty-four applications have been approved and one is under review. Department of State Lands data indicates that uranium prospecting is occurring in several Montana counties. Those counties in which active prospecting permits have been granted are identified in Table II-14.

TABLE II-14

**Recent Active Prospecting Permits in Montana Counties, 1975**

| Permittee | County |
|---|---|
| Continental Oil Company | Jefferson |
| Exxon | Carter |
| Felmont | Carter |
| Gulf | Musselshell |
| Kerr-McGee | Carter |
| Mobil | Carter |
| Mobil | Chouteau |
| Mobil | Liberty |
| Mobil | Powder River |
| Mobil | Toole |
| Pioneer Nuclear | Carter |
| Utah International | Broadwater |
| Utah International | Lewis & Clark |
| Utah International | Madison |
| Wyoming Mineral Company | Fergus |
| Wyoming Mineral Company | Judith Basin |
| Wyoming Mineral Company | Musselshell |

SOURCE: Data provided by Montana Department of State Lands.

## SOLAR—WIND—BIOFUELS

Energy from renewable sources is attracting increased attention as fossil fuels near depletion. Solar energy, wind power, geothermal power and biofuels may offer Montanans alternatives to reliance upon more conventional sources of energy.

Dr. William Heronemus, one of the nation's leading wind energy experts, has informed the Alternative Energy Resources Organization (AERO) that Montana could become a net exporter of energy based upon development of the wind resource alone. Other sources of energy are available from wood wastes and animal, sewage and municipal wastes. Montana produces some 500,000 tons of garbage per year, of which approximately 450,000 tons could be processed for resource recovery and energy production. A research study has indicated that combustibles comprise nearly 60 percent of Montana's municipal wastes—this resource has about one-half the BTU value of one ton of Montana coal.[1]

Other studies have shown that animal wastes in Montana amount to about ten pounds per animal per day. Animal wastes can produce about four cubic feet of methane per pound.[2] Feedlot operations, which have difficulty disposing of animal wastes, could provide a substantial, if small-scale, energy resource. Further, human wastes from Montana's larger municipal areas are an untapped resource.

Solar energy insolation values have been studied at a few Montana sites. Solar energy now may be tapped directly as a source for space and water heating. Current experiments in solar heating of commercial and residential space in Montana should be monitored closely.

Finally, Montana is reputed to have significant geothermal potential in the western third of the state. Although geothermal technology is presently somewhat limited, improvements in that technology may lead to development of the Montana geothermal resource.

Additional and more detailed discussion of alternative energy resources in Montana may be found in the *Montana Energy Policy Study,* published by the Montana Environmental Quality Council in June 1975, and in Chapter V of this paper.

[1]*Population, Employment and Waste Generation Report for State of Montana Solid Waste Management and Resource Recovery Study*, Henningson, Durham and Richardson, December 1975

[2]Personal communications with the Alternative Energy Resources Organization, Billings, Montana, November 1975 and December 1975.

## ENERGY FLOW IN MONTANA

The flow of energy in Montana in 1974 is illustrated in Figure II-4. This figure was obtained from the Los Alamos Scientific Laboratory. Of particular interest is a ratio of "lost energy" to "used energy" (198.9 TBTU/163.5 TBTU = 1.22) indicating that considerably more of the energy consumed in Montana was lost than was put to constructive use. Note also that Montana was a net exporter of energy in 1974 (295.6 TBTU exported compared to 50.1 TBTU imported, for a net energy export of 245.5 TBTU). The Los Alamos data differs somewhat from that presented in Table II-8—the data in Table II-8 was generated by the Federal Energy Administration.

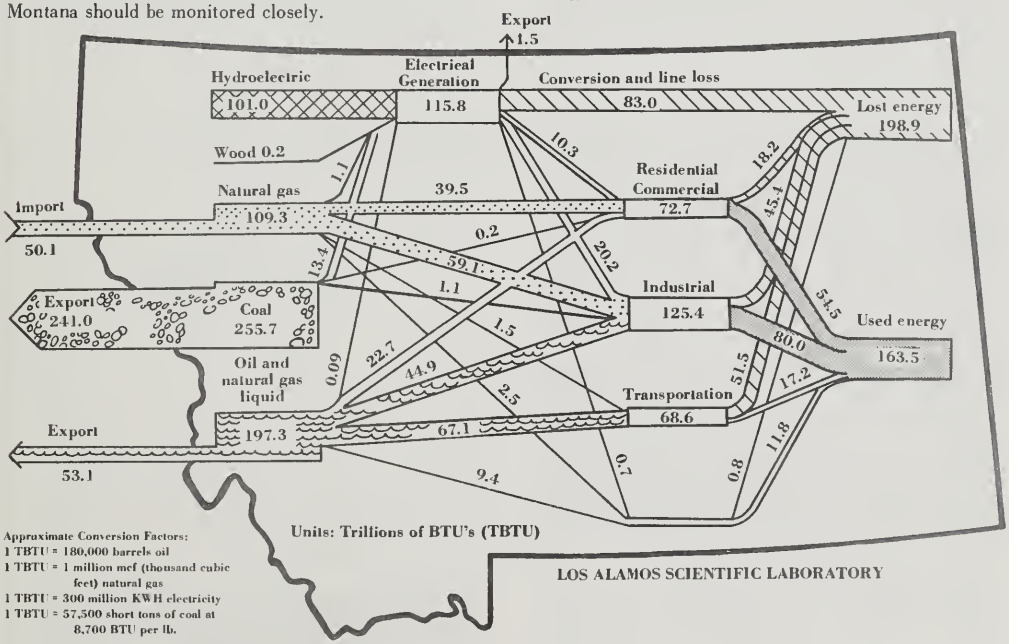



**Figure II-4: Energy Flow in Montana, 1974**

## ENERGY DATA

A review of the material presented on the previous pages indicates that reliable data on energy production, distribution and consumption in Montana are scarce. In light of the energy crisis facing Montana, and the nation, funds and man-hours should be committed to developing valid, reliable and detailed data on energy and to managing such data in an efficient manner. At present, energy-gathering efforts may provide results that are contradictory or incompatible. If public and governmental decision-makers are to resolve the energy crisis in a rational manner, more and better energy data must be made available. A significant effort to provide such data should be undertaken by state government. An initial step in this process should be the designation, staffing and funding of an energy data office. Centralization of energy data collection, analysis and management is necessary to the development of an efficient, coherent and coordinated energy data base. Such an energy data office should be located within the Governor's Office to ensure that its needs are met and that data reports are developed and distributed to decision-makers.

In the interim, a report will be published by the Montana Energy Advisory Council in late Spring of this year, presenting historical energy production and consumption data for fossil fuels and electricity.

# III. ENERGY DEVELOPMENT PROJECTIONS

Considerable attention has been given to the preparation of energy development projections in Montana, the region and the nation. Several such projections have been produced in the past three years. These projections vary in degree of comprehensiveness and in degree of sophistication. This chapter will present summaries of projections prepared by the Northern Great Plains Resource Program (NGPRP) and by a research team comprising staff at the University of Montana and Montana State University. Other available projections are not presented either because they do not differ substantially from the two below or because they do not match the sophistication of the Northern Great Plains Resource Program or Montana university projections. A series of national level projections may be found in *A Time To Choose*, Ford Foundation Energy Policy Project, 1974.

## NGPRP PROJECTIONS

The NGPRP coal development projections[3] are based upon energy demand forecasts presented in a Department of the Interior publication written in 1972 entitled *United States Energy Through the Year 2000*. According to the NGPRP, that publication forecasts an annual energy consumption growth rate of 3.6 percent per year. This forecast, according to NGPRP, "was essentially an extrapolation of historic trends" in energy consumption. As a result of that demand forecast, the NGPRP projected a year 2000 national energy demand of 191.9 quadrillion BTUs—two and one-half times the 1973 national energy consumption level! Since domestic reserves of fossil fuels other than coal are nearing depletion ,much of the brunt of meeting that increased energy demand is to fall upon coal and nuclear power. Recent developments and problems in the realm of nuclear power may be taken to indicate that the projected nuclear potential may not be reached. Should this be the case, increased pressure upon coal resources could be a result.

The NGPRP coal development profiles were described as follows:

CDP I: A rate of coal production sufficient to meet contractual agreements and regional increases in the demand for coal.

CDP II: A rate of coal development for export, in-region power generation, electrical export, and synthetic natural gas production.

CDP III: A rate of coal production based upon the maximum contribution that Northern Great Plains coal might reasonably be expected to make in alleviating shortages in the supply of imported oil and gas and domestic nuclear electric generation.

Projected coal development in Montana under each CDP is presented in Table III-1. The Montana Energy Advisory Council has estimated that nearly 43 million tons of Montana coal will be mined by 1980—this figure exceeds both the CDP I and CDP II projections for 1980.

[3]*Effects of Coal Development in the Northern Great Plains: A Review of Major Issues and Consequences at Different Rates of Development*, Northern Great Plains Resource Program, April 1975.

**TABLE III-1**

**Montana Coal Production Under NGPRP Coal Development Profiles (millions of tons)**

| | 1975 | 1980 | 1985 | 2000 |
|---|---|---|---|---|
| CDP I | 20 | 34 | 39 | 58 |
| CDP II | 20 | 41 | 75 | 133 |
| CDP III | 20 | 64 | 153 | 393 |

**SOURCE:** Northern Great Plains Resource Program.

The NGPRP also projected the development of energy conversion facilities in each state under each development profile. These projections are presented in Table III-2.

## TABLE III-2

### Energy Development Facilities Projected Under NGPRP Coal Development Profiles, Montana, 1980, 1985, 2000

| Development Facility | 1980 | | | 1985 | | | 2000 | | |
|---|---|---|---|---|---|---|---|---|---|
| | CDP I | CDP II | CDP III | CDP I | CDP II | CDP III | CDP I | CDP II | CDP III |
| Export Mine | 0 | 1 | 1 | 0 | 2 | 5 | 1 | 2 | 17 |
| Elec. Generation* | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 |
| Gasification** | 0 | 0 | 3 | 0 | 3 | 5 | 0 | 3 | 7 |

* 1025 megawatt facility.
**250 mmcf. per day facility.

SOURCE: Northern Great Plains Resource Program.

Coal development on any but the smallest scale will bring population increases. The population increases projected by the NGPRP, as a function of the three coal development profiles, are presented in Table III-3. The projections are for the "principal impact area" of Montana, defined as Big Horn, Custer, Musselshell, Powder River, Rosebud, Treasure and Yellowstone Counties. Percent change in population has been calculated between each year noted. One experienced researcher[4] of growth impacts has stated that most rural areas can absorb a 5 percent increase in population without much strain. Growth on the order of 5 to 10 percent imposes significant strains on rural areas. Tremendous problems are encountered when growth reaches the realm of 15 percent. Note that most of the population increases foreseen by the NGPRP are in excess of 10 percent—several are in excess of 15 percent.

[4]John S. Gilmore, Senior Research Economist, Denver Research Institute, University of Denver.

## TABLE III-3

### NGPRP Estimates of Population Increases Induced by Development Profiles, "Principal Impact Area" of Montana*

| | 1970 | 1980 | % Change 1970-1980 | 1985 | % Change 1980-1985 | 2000 | % Change 1985-2000 |
|---|---|---|---|---|---|---|---|
| CDP I | 123,000 | 142,000 | + 15.0 | 135,000 | - 5.0 | 157,000 | + 16.3 |
| CDP II | | 144,000 | + 17.1 | 179,000 | + 24.3 | 187,000 | + 4.4 |
| CDP III | | 180,000 | + 46.3 | 203,000 | + 12.8 | 267,000 | + 31.5 |

* Big Horn, Custer, Musselshell, Powder River, Rosebud, Treasure, Yellowstone Counties.

SOURCE: Northern Great Plains Resource Program.

The NGPRP estimates of Montana employment associated with the coal development profiles are presented in Table III-4. Estimates of housing demand imposed by energy development under the two NGPRP profiles are presented in Table III-5, for selected Montana communities.

## TABLE III-4

**NGPRP Estimates of Employment in the "Principal Impact Area" By Development Profile, Montana**

| | CDP I | | | CDP II | | | CDP III | | |
|---|---|---|---|---|---|---|---|---|---|
| **Montana** | **1980** | **1985** | **2000** | **1980** | **1985** | **2000** | **1980** | **1985** | **2000** |
| Direct Operating | 1,000 | 1,000 | 2,000 | 1,000 | 4,000 | 6,000 | 4,000 | 7,000 | 14,000 |
| Construction | 1,000 | - | 1,000 | 1,000 | 3,000 | 1,000 | 4,000 | 3,000 | 2,000 |
| Indirect | 7,000 | 3,000 | 7,000 | 7,000 | 20,000 | 17,000 | 22,000 | 26,000 | 40,000 |
| Totals | 9,000 | 4,000 | 10,000 | 9,000 | 27,000 | 24,000 | 30,000 | 36,000 | 56,000 |

SOURCE: *Draft Northern Great Plains Resource Program Interim Report*, September 1974, Page V-5.

## TABLE III-5

**Increased Housing Needs for Selected Montana Communities — Operational Phase Development CDPs II, III — 1980, 1985, 2000**

| Town | CDP | 1970 | 1980 | 1985 | 2000 |
|---|---|---|---|---|---|
| Hardin | II | 1,000 | - | - | 2,000 |
| | III | - | - | 2,000 | 7,000 |
| Forsyth | II | - | - | 1,000 | - |
| | III | - | 1,000 | - | 1,000 |
| Colstrip | II | 400 | 1,000 | 1,000 | - |
| | III | - | 2,000 | 2,000 | 1,000 |
| Lame Deer | II | 500 | - | - | - |
| | III | - | - | 2,000 | - |

SOURCE: Northern Great Plains Resource Program.

The NGPRP also developed estimates of the increases in school enrollment that might be induced by energy industrialization of the sort forecast in the development profiles. These estimates are presented in Table III-6. The enrollment estimates refer **only** to the operational phase of development, **not** to the construction phase. During construction, population increases will be larger and occur at a much more rapid rate, thereby producing greater strains upon the area. The cost estimates contained in Table III-6 refer to capital facilities expenditures. These latter expenditures must be met by voted bond issues in the affected school district or with federal impact assistance under P.L. 815. To date, no Montana community has received assistance under P.L. 815. The only state monies available to meet such expenditures are those collected under the new Montana coal tax (q.v., 84-1312 R.C.M. 1947; 50-1701 R.C.M. 1947).

The NGPRP projections are limited in several respects. The possible effects of increased prices on demand for energy, the possible effects of energy conservation, and the possibility of interfuels substitution as a function of price increases have not been addressed.

TABLE III-6

**Number of School Age Children and Associated Capital Cost Required to Provide Necessary Facilities Resulting From the Operational Phase of Coal Development — Selected Montana Communities CDPs II, III — 1980, 1985, 2000**

| City | Number of Students 1973-74 | CDP | Number of Students 1980 | Cost Millions of Dollars | Number of Students 1985 | Cost Millions of Dollars | Number of Students 2000 | Cost Millions of Dollars |
|---|---|---|---|---|---|---|---|---|
| Hardin | 1,700 | II | 130 | 0.5 | 130 | 0.5 | 1,600 | 6.4 |
| | | III | 130 | - | 1,600 | 6.4 | 6,650 | 25.7 |
| Forsyth | 660 | II | 3,000 | 11.6 | 700 | 2.6 | 700 | 2.6 |
| | | III | 700 | 2.6 | 1,000 | 3.9 | 1,300 | 5.1 |
| Colstrip | 340 | II | 1,000 | 3.9 | 1,600 | 6.4 | 1,600 | 6.4 |
| | | III | 1,600 | 6.4 | 2,900 | 11.6 | 3,900 | 15.4 |
| Lame Deer | 340 | II | - | - | - | - | - | - |
| | | III | - | - | 1,600 | 6.4 | 1,600 | 6.4 |

**SOURCE:** Northern Great Plains Resource Program.

## MONTANA UNIVERSITY COAL DEMAND STUDY

The *Montana University Coal Demand Study* was conducted in an attempt to clarify prior coal development projections. This study analyzes potential markets for Northern Great Plains (NGP) and Montana coal as a function of mine mouth, transportation and facility *(e.g.*, air pollution control equipment) costs of that coal. The study also poses various levels of coal development in Montana.

The authors of the *Montana University Coal Demand Study* have concluded that the market for NGP coal is very sensitive to air pollution control requirements. If federal air pollution control regulations require flue gas desulfurization and/or low sulfur coal for both new and existing coal-fired electric generating plants, a 21-state "expanded" market for NGP coal will result. If tall stacks and/or intermittent control systems are permitted, a 13-state market for NGP coal will result.

The authors proposed several annual rates of growth in electric generation and several price levels of electric energy in deriving their coal development estimates. Of these levels, the "most reasonable" assumption includes a short-term (to 1980) annual electrical generation growth rate of 5 percent, a long-term electrical generation growth rate of 3 to 5 percent and annual electric price increases on the order of 1 to 3 percent. The authors also have assumed that coal-fired electric power plants will continue to maintain their current proportion of energy generation, that the NGP area will continue to supply coal within its market area on the basis of the 1980 contract based share of coal production and that air pollution emission controls will be required for all power plants.

Data presented in Tables III-7 and III-8 indicate Montana coal production projections under various market assumptions. The Montana projections were derived from the projected NGP area totals on the basis of their projected 1980 contract share of total NGP coal production. In short, Montana coal production has been projected to occur as a constant proportion—27.6 percent—of total NGP coal production. The authors state that a change in any of the assumptions will be reflected in projected coal production tonnages.

## TABLE III-7

**Coal Production in Montana for Electrical Generation Based on the Assumption That Montana Will Produce 27.6% of All NGP Coal (Its 1980 Contract Based Share)**

| General Assumptions | Electrical Generation Growth Assumptions (Constant Growth) | Montana Coal Production (millions of tons) 1980 | 1985 | 2000 |
|---|---|---|---|---|
| 1. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all coal for electric generation within its market area, emission control required for all power plants. | 1% | 43 | 45 | 52 |
| | 3% | 49 | 57 | 88 |
| | 5% | 56 | 71 | 148 |
| 2. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all coal for electric generation within its market area, SCS* permitted for old power plants, emission control required for new plants. | 1% | 12 | 14 | 21 |
| | 3% | 18 | 26 | 58 |
| | 5% | 25 | 41 | 118 |
| 3. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all coal for electric generation within its market area, SCS permitted for all power plants. | 1% | 10 | 10 | 12 |
| | 3% | 11 | 13 | 20 |
| | 5% | 13 | 16 | 34 |
| 4. Constant electrical generation growth, coal-fired plants supply residual share** of electric generation, NGP supplies all coal for electric generation within its market area, emission control required for all power plants. | 1% | 38 | 14 | 19 |
| | 3% | 54 | 44 | 82 |
| | 5% | 72 | 82 | 178 |
| 5. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all coal for electric generation within its market area, SCS permitted for old power plants, emission control required for new plants. | 1% | 5 | 0 | 0 |
| | 3% | 21 | 11 | 48 |
| | 5% | 39 | 48 | 144 |
| 6. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all coal for electric generation within its market area, SCS permitted for all power plants. | 1% | 5 | 0 | 0 |
| | 3% | 16 | 10 | 39 |
| | 5% | 28 | 35 | 109 |
| 7. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply its 1980 contract based share of coal market, emission control required for all power plants. | 1% | 37 | 30 | 35 |
| | 3% | 37 | 38 | 50 |
| | 5% | 37 | 48 | 99 |
| 8. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for old power plants, emission control required for new plants. | 1% | 37 | 9 | 14 |
| | 3% | 37 | 17 | 39 |
| | 5% | 37 | 27 | 79 |

*SCS equals "supplementary control systems".

**The residual share of the electrical generation fuel mix is that remaining nuclear, hydroelectric, gas- and oil-fired generations are projections.

**Table III-7 (Cont.)**

| General Assumptions | Electrical Generation Growth Assumptions (Constant Growth) | Montana Coal Production (millions of tons) 1980 | 1985 | 2000 |
|---|---|---|---|---|
| 9. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for all power plants. | 1% | 24 | 19 | 22 |
| | 3% | 24 | 24 | 37 |
| | 5% | 24 | 30 | 62 |
| 10. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, emission control required for all power plants. | 1% | 37 | 7 | 10 |
| | 3% | 37 | 23 | 43 |
| | 5% | 37 | 42 | 92 |
| 11. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for old power plants, emission control required for new plants. | 1% | 37 | 0 | 0 |
| | 3% | 37 | 5 | 25 |
| | 5% | 37 | 25 | 75 |
| 12. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for all power plants. | 1% | 24 | 0 | 0 |
| | 3% | 24 | 9 | 33 |
| | 5% | 24 | 29 | 92 |
| 13. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all new coal within its market area, emission control required for all power plants. | 1% | 12 | 14 | 21 |
| | 3% | 18 | 26 | 56 |
| | 5% | 25 | 40 | 117 |
| 14. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all new coal within its market area, SCS permitted for old power plants, emission control required for new plants. | 1% | 12 | 14 | 21 |
| | 3% | 18 | 26 | 56 |
| | 5% | 25 | 40 | 117 |
| 15. Constant electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all new coal within its market area, SCS permitted for all plants. | 1% | 9 | 10 | 12 |
| | 3% | 11 | 13 | 20 |
| | 5% | 13 | 16 | 34 |
| 16. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all new coal within its market area, emission control required for all power plants. | 1% | 7 | 0 | 0 |
| | 3% | 23 | 13 | 51 |
| | 5% | 41 | 51 | 147 |
| 17. Constant electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all new coal within its market area, SCS permitted for old power plants, emission control required for new plants. | 1% | 7 | 0 | 0 |
| | 3% | 23 | 13 | 51 |
| | 5% | 41 | 51 | 147 |
| 18. Constant electrical generation growth, coal-fired plants supply residual share of electrical generation, NGP supplies all new coal within its market area, SCS permitted for all power plants. | 1% | 5 | 0 | 0 |
| | 3% | 16 | 10 | 39 |
| | 5% | 27 | 35 | 109 |

**SOURCE:** Silverman, *et al., Montana University Coal Demand Study*, 1976.

## TABLE III-8

**Coal Production in Montana for Electrical Generation Based on the Assumption That Montana Will Produce 27.6% of All NGP Coal (Its 1980 Contract Based Share) At Different Electric and Natural Gas Price Increase Assumptions**

| General Assumptions | Electric-Gas Price Increase Assumptions | Montana Coal Production (millions of tons) 1980 | 1985 | 2000 |
|---|---|---|---|---|
| 1. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation. NGP supplies all coal for electric generation within its market area, emission control required for all power plants. | 0%, 0% | 59 | 73 | 113 |
| | FPC, 3% | 58 | 68 | 94 |
| | 3%, 5% | 52 | 55 | 49 |
| | 5%, 7% | 48 | 46 | 28 |
| 2. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all coal for electric generation, SCS* permitted for old power plants, emission control required for new plants. | 0%, 0% | 29 | 42 | 82 |
| | FPC, 3% | 27 | 38 | 63 |
| | 3%, 5% | 22 | 25 | 18 |
| | 5%, 7% | 18 | 16 | 0 |
| 3. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP supplies all coal for electric generation within its market area, SCS permitted for all power plants. | 0%, 0% | 14 | 17 | 27 |
| | FPC, 3% | 14 | 16 | 23 |
| | 3%, 5% | 12 | 13 | 12 |
| | 5%, 7% | 11 | 11 | 7 |
| 4. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all coal for electric generation within its market area, emission control required for all power plants. | 0%, 0% | 80 | 85 | 134 |
| | FPC, 3% | 76 | 74 | 104 |
| | 3%, 5% | 63 | 41 | 21 |
| | 5%, 7% | 52 | 17 | 0 |
| 5. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all coal for electric generation, SCS permitted for old power plants, emission control required for new plants. | 0%, 0% | | | |
| | FPC, 3% | 47 | 52 | 101 |
| | 3%, 5% | 43 | 41 | 71 |
| | 5%, 7% | 29 | 7 | 0 |
| | | 19 | 0 | 0 |
| 6. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP supplies all coal for electric generation within its market area, SCS permitted for all power plants. | 0%, 0% | 36 | 42 | 83 |
| | FPC, 3% | 33 | 35 | 59 |
| | 3%, 5% | 24 | 12 | 0 |
| | 5%, 7% | 17 | 0 | 0 |
| 7. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply 1980 contract based share of coal market, emission control required for all power plants. | 0%, 0% | 37 | 47 | 73 |
| | FPC, 3% | 37 | 44 | 61 |
| | 3%, 5% | 37 | 36 | 32 |
| | 5%, 7% | 37 | 30 | 18 |
| 8. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for old power plants, emission control required for new plants. | 0%, 0% | 37 | 27 | 53 |
| | FPC, 3% | 37 | 25 | 41 |
| | 3%, 5% | 37 | 16 | 12 |
| | 5%, 7% | 37 | 10 | 0 |
| 9. Price sensitive electrical generation growth, coal-fired plants continue to maintain current share of generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for all power plants. | 0%, 0% | 24 | 30 | 48 |
| | FPC, 3% | 24 | 28 | 39 |
| | 3%, 5% | 24 | 23 | 20 |
| | 5%, 7% | 24 | 19 | 12 |

*SCS equals "supplementary control systems".

**Table III-8 (Cont.)**

| General Assumptions | Electric-Gas Price Increase Assumptions | Montana Coal Production (millions of tons) 1980 | 1985 | 2000 |
|---|---|---|---|---|
| 10. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, emission control required for all power plants. | 0%, 0% | 37 | 42 | 66 |
| | FPC, 3% | 37 | 36 | 51 |
| | 3%, 5% | 37 | 20 | 10 |
| | 5%, 7% | 37 | 8 | 0 |
| 11. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for old power plants, emission control required for new plants. | 0%, 0% | 37 | 25 | 49 |
| | FPC, 3% | 37 | 20 | 35 |
| | 3%, 5% | 37 | 4 | 0 |
| | 5%, 7% | 37 | 0 | 0 |
| 12. Price sensitive electrical generation growth, coal-fired plants supply residual share of electric generation, NGP continues to supply its 1980 contract based share of coal market, SCS permitted for all power plants. | 0%, 0% | 24 | 30 | 59 |
| | FPC, 3% | 24 | 25 | 42 |
| | 3%, 5% | 24 | 9 | 0 |
| | 5%, 7% | 24 | 0 | 0 |

**SOURCE:** Silverman, *et al.*, Montana University Coal Demand Study, 1976.

The two previous tables indicate much lower levels of coal production for Montana under high development profiles. According to the authors of the *Montana University Coal Demand Study,* very large-scale coal development in Montana will require (a) a continuation of the historic rate of growth in consumption of electricity, and (b) considerable conversion of coal to synthetic natural gas and/or synthetic liquid hydrocarbons, petrochemicals and fertilizer.

In contrast to most projections of coal development in the NGP area, the *Montana University Coal Demand Study* states that coal gasification activities are not likely to reach high levels. The authors of the study base this statement on "traditional economic analyses" which indicate that price and technological constraints will place synthetic gas in a noncompetitive position (see Chapter IV for additional comments). The *Montana University Coal Demand Study* projections of coal gasification activities in the NGP area are presented in Table III-9.

**TABLE III-9**

**Coal Gasification in the Northern Great Plains**

| Coal Gasification Plants in the Northern Great Plains | | | |
|---|---|---|---|
| **Development Level** | **1980** | **1985** | **2000** |
| Most Probable | 0 | 0 | 0 |
| Low | 0 | 0 | 0 |
| High | 0 | 3 | 3 |

**NOTE:** All plants rated at 250 MM scf./day. One plant each will be located in Montana, Wyoming and North Dakota in the high estimates.

**Table III-9 (Cont.)**

**Coal Requirements for Gasification Plants in the Northern Great Plains (Million Tons Per Year)**

| | 1980 | 1985 | 2000 |
|---|---|---|---|
| Most Probable | 0 | 0 | 0 |
| Low | 0 | 0 | 0 |
| High | 0 | 36.6 | 36.6 |

**NOTE:** Each plant requires 12,200,000 tons per plant-year of operation.

**SOURCE:** Silverman, *et. al., Montana University Coal Demand Study,* 1976.

## KNOWN AND PROPOSED MAJOR ENERGY DEVELOPMENT ACTIVITIES IN MONTANA

The following tables present a brief description of known and proposed energy development activities in Montana.

## TABLE III-10

### Existing and Proposed Coal Strip Mines, Montana

| Company | Site | Mine Capacity* (million tons) | Production Date |
|---|---|---|---|
| Decker Coal Company | North Decker** | 2.0 | 1977 |
| Decker Coal Company | East Decker** | 6.7 | 1978 |
| Decker Coal Company | West Decker | 8.2 | 1975 |
| Western Energy Company | Colstrip | 10.0*** | 1976 |
| Westmoreland Resources | Sarpy Creek | 4.0 - 6.5 | 1975-77 |
| Knife River | Savage | 0.32 | 1975 |
| Peabody | Colstrip | 3.0 | 1975 |

* The term "mine capacity" indicates the estimated total production possible at a mine site. Actual production at a given site will vary according to sales contracts, equipment availability and approval from various governmental review bodies.
** Proposed mine.
***Contingent upon approval of Colstrip Units III and IV, or new contracts.

## TABLE III-11

### Existing and Proposed Major Coal Conversion Facilities, Montana

| Company | Project | Plant Type | Plant Capacity | Site | Production Date |
|---|---|---|---|---|---|
| Montana Power Co. 50% | Colstrip I | Coal-Fired Elec. Gen. | 330 Megawatts | Colstrip | 7/75 |
| and Puget Sound, Power | Colstrip II | Coal-Fired Elec. Gen. | 330 Megawatts | Colstrip | 7/76 |
| & Light 50% | Colstrip III* | Coal-Fired Elec. Gen. | 660 Megawatts | Colstrip | ? |
| | Colstrip IV* | Coal-Fired Elec. Gen. | 660 Megawatts | Colstrip | ? |
| Burlington Northern | Circle West** | Synfuels | | Circle | |
| | Stage 1 | Ammonia | 1,000-3,000 tons/day | Circle | late 70's |
| | Stage 2 | Methyl Fuel | 17,800-35,600 bbls/day | Circle | mid 80's |
| | Stage 3 | Diesel Fuel | 10,000-30,000 bbls/day | Circle | mid-late 80's |

* Proposed development project (applicant companies: Montana Power Company, Puget Sound, Power and Light, Portland General Electric Company, Pacific Power and Light Company and Washington Water Power Company).
** Proposed development project.

The potential of the Glasgow Air Force Base as an energy production site recently has been discussed. One proposal envisioned the consumption of some 76 million tons of coal per year and the production of various synthetic fuels at that site. Both the Governor and the Lieutenant Governor of Montana have indicated that development on the scale proposed would be unacceptable. However, the Glasgow base remains a potentially attractive site for energy industrialization, due to the existence of numerous housing and other facilities and the close proximity of water.

# IV. CONSTRAINTS ON ENERGY DEVELOPMENT IN MONTANA

Discussion of the possible constraints and limits to energy industrialization seldom have received prominence in current proposals and plans to cope with the energy crisis. Although mention of limits and difficulties may be made, such matters seldom seem to be considered important enough to influence the outcome of the proposal or plan at issue. In addition, such matters often are considered in isolation from each other; one rarely reads a discussion of limits in the context of their existence as an integrated problem of significance that must be resolved.

Constraints on energy development exist in a number of dimensions. Among these dimensions are:

Natural Resources
Capital
Manpower
Market Concerns
Technology
Policy and Law
Public Demand and Attitudes

The remainder of this chapter will be devoted to an identification and brief discussion of development constraints within these dimensions.

## NATURAL RESOURCES

**Energy Reserves:** The magnitude of oil shale and coal reserves in this nation, compared to that of oil and natural gas, appears to have convinced energy policy-makers that coal and oil shale are practically infinite resources. Assuming that technologies were available to convert these resources to practical alternatives to oil and gas, and that all those resources could be developed feasibly, those resources could be considered practically infinite, *at current levels of consumption.* A difficulty arises when one considers the extent to which coal and oil shale are to be used if national energy consumption grows at the rate the federal and industrial planners insist it must. This difficulty is compounded when one considers the setbacks that have occurred in the nuclear power program (technological setbacks and increasing public and scientific concern with nuclear safety), which will put additional pressure on conventional resources.

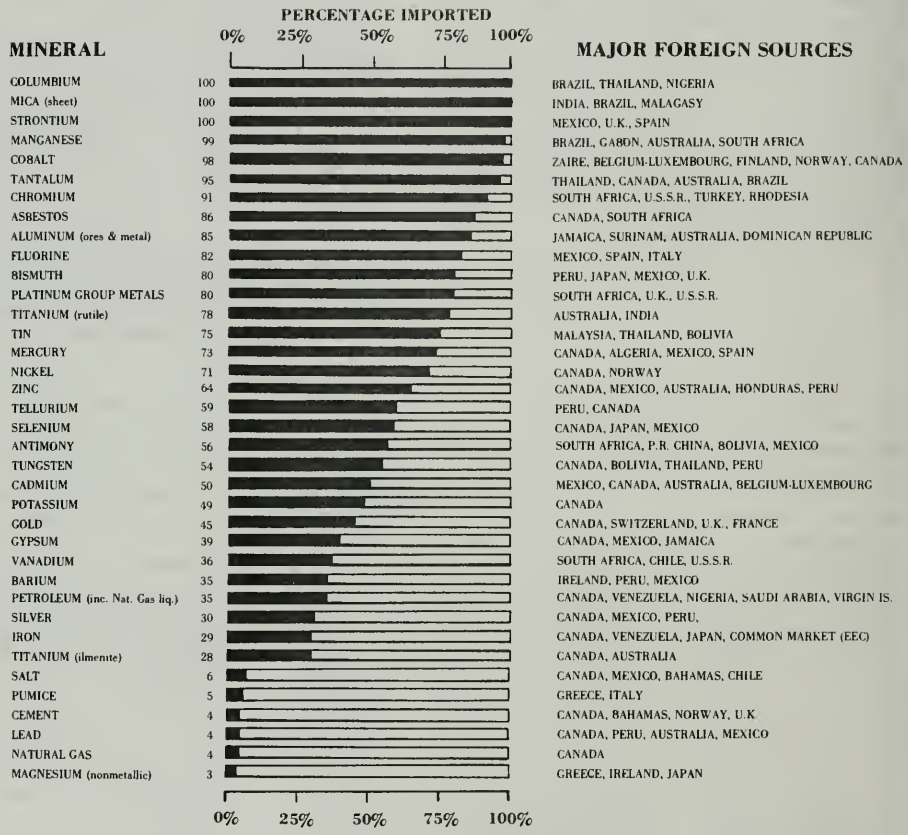
An analogy may clarify the issue of energy resource availability. The National Economic Research Association (NERA) published an interesting paper concerning the longevity of a hypothetical fossil fuel reserve.[5] In their paper, they assumed the existence of a demonstrated total fossil fuel reserve that would sustain 1,000 years of use at current consumption levels. Applying a simple mathematical formula, the authors sought to determine how long that 1,000-year reserve would last at an energy consumption growth rate of 3.5 percent per year. They found that the 1,000-year fossil fuel reserve would be depleted in 104 years. Doubling the size of the original energy reserve, the authors found that it would be depleted in 124 years at a 3.5 percent energy use growth rate. The authors also found that at 3.5 percent growth in energy use, a 10,000-year reserve would be depleted in only 170 years. It would be difficult to find scientists or planners who would insist that the world's fossil fuel reserves would sustain even 1,000 years of consumption at current levels of use. The NERA analogy, while not representative of rates of energy growth now promoted at the national level (about 2% per year), does indicate the futility of attempting to cope with a shortage of a finite resource by increasing the availability of that resource.

Alternative resources, such as fissionable radioactive materials, also are in short supply, as well as being hazardous materials. Although we have been promised technologies that will produce fission fuels (*e.g.*, breeder reactors) and that will rely on virtually infinite resources (*e.g.*, fusion reactors), advances in that direction have not kept up with the promises. It appears foolish to commit the future to a wager with, at best, 50-50 odds, when less grandiose but lower risk alternatives are available.

**Other Raw Materials:** The industrialized nations of the world are heavily dependent upon not only energy reserves but also natural resources that can be fashioned into durable products. The most heavily industrialized nations import these as well as energy resources. Figure IV-1 indicates the 1975 dependence of the United States upon imported strategic materials. It should be noted that some of these resources are imported from nations that are potentially as "hostile" to the nation's interests as Arab nations are said to be.

Expansion of energy development activities will place greatly increased demands upon finite raw materials. These materials will be necessary for the construction of mining equipment, energy conversion facilities, energy transportation systems, associated municipal developments, and so on. In this case, the nation either must import more of those materials, develop lower quality domestic sources or must reallocate them within the nation's economy.

[5]Roseman, *Compound Growth Rates and the Resource Base,* National Economic Research Associates, Inc., Washington, D.C., September 1973.


PERCENTAGE IMPORTED
0% 25% 50% 75% 100%
MINERAL
MAJOR FOREIGN SOURCES
COLUMBIUM 100 BRAZIL, THAILAND, NIGERIA
MICA (sheet) 100 INDIA, BRAZIL, MALAGASY
STRONTIUM 100 MEXICO, U.K., SPAIN
MANGANESE 99 BRAZIL, GABON, AUSTRALIA, SOUTH AFRICA
COBALT 98 ZAIRE, BELGIUM-LUXEMBOURG, FINLAND, NORWAY, CANADA
TANTALUM 95 THAILAND, CANADA, AUSTRALIA, BRAZIL
CHROMIUM 91 SOUTH AFRICA, U.S.S.R., TURKEY, RHODESIA
ASBESTOS 86 CANADA, SOUTH AFRICA
ALUMINUM (ores & metal) 85 JAMAICA, SURINAM, AUSTRALIA, DOMINICAN REPUBLIC
FLUORINE 82 MEXICO, SPAIN, ITALY
BISMUTH 80 PERU, JAPAN, MEXICO, U.K.
PLATINUM GROUP METALS 80 SOUTH AFRICA, U.K., U.S.S.R.
TITANIUM (rutile) 78 AUSTRALIA, INDIA
TIN 75 MALAYSIA, THAILAND, BOLIVIA
MERCURY 73 CANADA, ALGERIA, MEXICO, SPAIN
NICKEL 71 CANADA, NORWAY
ZINC 64 CANADA, MEXICO, AUSTRALIA, HONDURAS, PERU
TELLURIUM 59 PERU, CANADA
SELENIUM 58 CANADA, JAPAN, MEXICO
ANTIMONY 56 SOUTH AFRICA, P.R. CHINA, BOLIVIA, MEXICO
TUNGSTEN 54 CANADA, BOLIVIA, THAILAND, PERU
CADMIUM 50 MEXICO, CANADA, AUSTRALIA, BELGIUM-LUXEMBOURG
POTASSIUM 49 CANADA
GOLD 45 CANADA, SWITZERLAND, U.K., FRANCE
GYPSUM 39 CANADA, MEXICO, JAMAICA
VANADIUM 36 SOUTH AFRICA, CHILE, U.S.S.R.
BARIUM 35 IRELAND, PERU, MEXICO
PETROLEUM (inc. Nat. Gas liq.) 35 CANADA, VENEZUELA, NIGERIA, SAUDI ARABIA, VIRGIN IS.
SILVER 30 CANADA, MEXICO, PERU,
IRON 29 CANADA, VENEZUELA, JAPAN, COMMON MARKET (EEC)
TITANIUM (ilmenite) 28 CANADA, AUSTRALIA
SALT 6 CANADA, MEXICO, BAHAMAS, CHILE
PUMICE 5 GREECE, ITALY
CEMENT 4 CANADA, BAHAMAS, NORWAY, U.K.
LEAD 4 CANADA, PERU, AUSTRALIA, MEXICO
NATURAL GAS 4 CANADA
MAGNESIUM (nonmetallic) 3 GREECE, IRELAND, JAPAN
0% 25% 50% 75% 100%

* APPARENT CONSUMPTION = U.S. PRIMARY + SECONDARY PRODUCTION + NET IMPORT RELIANCE

**NET IMPORT RELIANCE = IMPORTS—EXPORTS + GOV'T STOCKPILE RELEASES + INDUSTRY STOCK CHANGES

**BUREAU OF MINES, U.S. DEPARTMENT OF THE INTERIOR (Import-export data from Bureau of the Census)**

**FIGURE IV-1:** United States Imports of Strategic Materials, 1975.
**SOURCE:** Bureau of Mines, U.S. Department of the Interior, 1976.

**Water:** The availability of water will affect and be affected by energy development to a significant degree, particularly in western regions. Water quantity and quality will be influenced by the type and scope of energy development. Strip mining in alluvial valley floors may lower water tables. Strip mining also may affect water quality even after reclamation, where the mined seam was an aquifer and the overburden contains soluble materials. The aquifer may reestablish itself through the replaced overburden, and, in such cases, will leach the soluble minerals causing increased mineralization in both ground and surface waters. Water is an essential ingredient in many coal conversion processes, either as a coolant or as a reactant. Although the requirements of individual plants may be relatively small, the cumulative (and constant) water demands of large-scale development will be most significant, particularly in arid and semi-arid regions. In addition to industrial demands for water, large-scale development will increase municipal and recreational demands for the resource.

Sufficient water may be available to support rather large-scale industrial development, given certain conditions such as increased storage and aqueduct capacity. However, one should remember that other economic and human activities also will place increased demands upon the water resource above and beyond that imposed by industrial and related developments. As competitive demands for limited water resources grow, the relative availability of the resource will become increasingly important in development decisions, in all sectors. The NGPRP has stated that costly water supplies could affect the level of industrial water use and perhaps even plant siting.[6]

Proposals to increase water storage capacities themselves impose significant demands upon a limited economic and natural resource base. Dams, diversions and aqueducts impose significant energy, materials and socio-economic costs. The point of this discussion is to indicate that the decision to use any resource, even one which appears relatively abundant, immediately changes the dimensions of its abundance and poses costs which a superficial analysis would miss.

**Land:** Obviously, if coal is to be mined, land will be disturbed. For the course of the mining activity, mined land essentially will be unavailable for other uses, whether reclaimed or not. The NGPRP has estimated that strip mined land may be reclaimed for single crop use in about five years. Land reclamation to a degree that would allow grazing is estimated to take ten years; restoration of wildlife habitat is estimated to require 25 years.[7]

The feasibility of mined land reclamation is in question in some areas. The National Academy of Sciences has published its contention that reclamation cannot be achieved in arid areas, and is questionable in some semi-arid areas.[8] Although plot reclamation can doubtless be achieved almost anywhere, it can be an extremely expensive proposition. If a high level of irrigation and fertilization is required to sustain a reclaimed area, the associated energy, water and materials expenses can effectively preclude economic use of that area.

Land areas disturbed by transportation corridors, plant and municipal sites and recreation areas induced by energy development probably will not be reclaimed. Although such land areas may be considered put to a higher productive use, that use is contingent upon the continued existence of the energy development activity which engendered it. Should energy development activity subside, associated activities also are likely to subside, leaving certain land areas permanently removed from other productive use.

**The Montana Outdoors:** The abundant wildlife, wildlands and open spaces of Montana are becoming increasingly unique in the urbanized United States. Wildlife species and vistas long since lost in the rest of the nation are relatively common in Montana. These resources are greatly valued by Montanans as they constitute a significant part of the "Montana life style". Millions of Americans annually visit Montana to share these resources by camping, hiking, fishing, photography and otherwise relaxing from the frantic pace of urban life. As a result, these resources support the recreation and tourism industry, a recognized sector of the Montana economy. The major economic sector of Montana, agriculture, also is sustained by the state's outdoor resources. Vast amounts of open space, clean air and clean water are required to support agricultural activities in the Northern Great Plains Region.

Plentiful as Montana's outdoor resources may be, they also are fragile. Wildlife, wildlands and open spaces, by definition, require areas with low population densities. Each year, thousands of acres of "undeveloped" lands, often critical wildlife ranges, are lost to second home and suburban development within Montana. Large-scale energy industrialization will accelerate this loss. Energy development, as mentioned previously, will impose direct and indirect demands upon the open land and clean air and water of Montana. Increased demands for these resources will be in competition with the many species of wildlife which are completely dependent upon them for survival. As each increment of critical winter range, forage, breeding grounds, clean water for spawning and other habitat dimensions is lost, a corresponding loss will be noted in wildlife populations. And, as each power plant, transmission line, water diversion, and new municipality is constructed, a corresponding loss in the aesthetic appeal of Montana will be felt by many Montanans and tourists.

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[6] *Effects of Coal Development in the Northern Great Plains: A Review of Major Issues and Consequences at Different Rates of Development*, Northern Great Plains Resource Program, April 1975.

[7] *Ibid.*

[8] *Rehabilitation Potential of Western Coal Lands*, a report to the Energy Policy Project of the Ford Foundation. National Academy of Sciences, Washington, D.C., 1973.

## CAPITAL

The capital requirements of large-scale energy industrialization are staggering. The costs of Colstrip Units I-IV are estimated to total at least $540 million.[9] Coal gasification plants now are expected to cost on the order of $1.2 billion. A 4 million ton per year strip mine is estimated to require $60-70 million before production is begun, depending upon rail spur, equipment, land acquisition and other costs.

The utility industry is reported to have had difficulty raising investment capital in recent years. The demand for electricity has failed to increase as projected and some planned facilities have been postponed. The costs of providing additional power, particularly peaking power, have increased, yet all rate increases must receive approval by public review bodies. The costs of construction of new facilities have increased markedly as has the uncertainty in the utility industry regarding what environmental standards will require and the degree to which they will be enforced. Such matters increase the difficulty of raising investment capital. Other investments may appear to pose better odds for investors. Federal concern over possible difficulties in raising energy investment capital has stimulated the development of federal programs to subsidize energy research and development and, in the case of synthetic fuels, to underwrite the market price of the final product.

Significant capital requirements also are imposed upon areas in which development is slated, particularly in isolated, rural areas. Development-induced population increases raise demands for roads, schools, water and sewage facilities, public utilities, housing, government services and so on. One estimate of the Montana local government cost associated with energy development (assuming in-state conversion of 40 million tons of coal per year) comes to $96 million in the first three years.[10] This figure does not include state government costs.

Many government impacts must be anticipated if they are to be met effectively. However, governments are bound by statutory limits in raising financial resources. As matters now stand in Montana, bonding capacities of counties are determined by their assessed valuation. The demands for increased expenditures precede the counties' fiscal ability to meet them.

Judging from the news media and the complaints of industry and local governments, there is no ready surplus of investment capital. Assuming a limited resource, both industry and impacted communities will be competing for that resource. Such competition can only make the resource more scarce and more expensive.

[9]Environmental impact statement prepared by the Department of Natural Resources and Conservation regarding Colstrip Units III and IV.

[10]*Coal Development Information Packet, Supplement I*, Montana Energy Advisory Council, July 1975.

## MANPOWER

Assuming that material and capital constraint difficulties are resolved, and massive energy development is pursued at the level envisioned by its proponents, considerable labor resources will be required. Experience at the Colstrip site has indicated that the Montana labor force was inadequate to fill all available jobs. The report of the Task Force on Synthetic Fuels from Coal (Project Independence)[11] has indicated that shortages of highly skilled labor will inhibit large-scale construction of sophisticated energy conversion facilities nationwide. Assuming that energy development in Montana will be mirrored by development elsewhere in the region and nation, Montana projects will be forced to compete with others for another finite resource—skilled labor. Competition for this resource, in many cases, will involve moving laborers from their current places of residence to some site in Montana. This may prove feasible, if no other sections of the country are competing with Montana. However, the amenities of living in Montana are not always perceived as such by those living elsewhere; job opportunities in other states and regions may prove more attractive.

Data presented in Tables IV-1 through IV-5 indicate the number and types of skilled laborers seen as necessary to the construction of various energy conversion facilities. These tables were taken from the *Task Force Report: Synthetic Fuels From Coal*, a publication of the Federal Energy Administration's Project Independence Program.

[11]*Task Force Report: Synthetic Fuels From Coal*, Project Independence Program, Federal Energy Administration, Washington, D.C.

## TABLE IV-1

### Manpower for Low BTU Plant Construction

Energy Resource: Coal
Facility Type: Fuel Gas

**Unit Capacity: 1.6 x $10^9$ scfd**

| Occupational Groups/ SIC Code | Years to On-Line Production | | | Total Man Years |
|---|---|---|---|---|
| | Year 1 Man Years | Year 2 Man Years | Year 3 Man Years | |
| Carpenter/415 | - | 26 | 5 | 31 |
| Cement/Cons. Fin./421 | - | 6 | 1 | 7 |
| Iron Worker/550 | - | 16 | 11 | 27 |
| Laborer/751 | - | 24 | 13 | 37 |
| Millwright/502 | - | 1 | 2 | 3 |
| Exc. Equip. Op./412 | - | 14 | 15 | 29 |
| Pipefitter/522 | - | 34 | 102 | 136 |
| Electrician/430 | - | 13 | 36 | 49 |
| Asb. Worker | - | 9 | 13 | 22 |
| Painter/510 | - | 2 | 7 | 9 |
| Sheet Metal Worker/535 | - | - | 2 | 2 |
| Mason/410 | - | 3 | - | 3 |
| Teamster/715 | - | 13 | 2 | 15 |
| Drafting/152 | 40 | - | - | 40 |
| Surveying/161 | 10 | - | - | 10 |
| Boilermaker/404 | - | 11 | 18 | 29 |
| Welder/228 | - | 12 | 6 | 18 |
| Engineering/010 | 5 | - | 2 | 7 |
| Engineering/011 | 8 | 3 | 2 | 13 |
| Engineering/012 | 5 | 2 | 2 | 9 |
| Engineering/014 | 5 | - | - | 5 |
| Engineering/021 | - | - | - | - |
| Engineering/002 | 10 | - | - | 10 |
| **Total of All Occupations** | **83** | **189** | **239** | **511** |

**SOURCE:** *Task Force Report:Synthetic Fuels From Coal,* Project Independence Program, Federal Energy Administration, Washington, D.C.

## TABLE IV-2

### Manpower for Lurgi Plant Construction

Energy Resource: Coal
Facility Type: Lurgi

**Unit Capacity: 250 x $10^6$ scfd**

| Occupational Groups/ SIC Code | Years to On-Line Production | | | | |
|---|---|---|---|---|---|
| | Year 1 Man Years | Year 2 Man Years | Year 3 Man Years | Year 4 Man Years | Total Man Years |
| Carpenter/415 | - | 48 | 106 | 12 | 166 |
| Cement/Cons. Fin./421 | - | 11 | 26 | - | 37 |
| Iron Worker/550 | - | 32 | 91 | 20 | 143 |
| Laborer/751 | - | 34 | 120 | 43 | 197 |
| Millwright/502 | - | 2 | 8 | 4 | 14 |
| Exc. Equip. Op./412 | - | 30 | 80 | 43 | 153 |
| Pipefitter/522 | - | 41 | 413 | 269 | 723 |
| Electrician/430 | - | 11 | 138 | 108 | 257 |
| Asb. Worker | - | 5 | 66 | 43 | 114 |
| Painter/510 | - | 3 | 19 | 28 | 50 |
| Sheet Metal Worker/535 | - | 1 | 5 | 3 | 9 |
| Mason/410 | - | 1 | 2 | - | 3 |
| Teamster/715 | - | 24 | 20 | 4 | 48 |
| Drafting/152 | 50 | - | - | - | 50 |
| Surveying/161 | 15 | - | - | - | 15 |
| Boilermaker/404 | - | 21 | 83 | 51 | 155 |
| Welder/228 | - | 25 | 80 | 15 | 120 |
| Engineering/010 | 28 | - | 5 | 4 | 37 |
| Engineering/011 | 37 | 8 | 17 | 7 | 69 |
| Engineering/012 | 28 | - | 5 | 3 | 36 |
| Engineering/014 | 28 | - | 5 | 5 | 38 |
| Engineering/021 | 10 | - | 4 | - | 14 |
| Engineering/002 | 56 | - | - | - | 56 |
| **Total of All Occupations** | **252** | **297** | **1,292** | **662** | **2,503** |

SOURCE: *Task Force Report: Synthetic Fuels From Coal*, Project Independence Program, Federal Energy Administration, Washington, D.C.

## TABLE IV-3

### Manpower for Fischer-Tropsch Plant Construction

Energy Resource: Coal
Facility Type: Fischer-Tropsch
**Unit Capacity: 100,000 BBL/Day Liquids—1.66 Billion scfd Gas**

| Occupational Groups/ SIC Code | Years to On-Line Production | | | | | |
|---|---|---|---|---|---|---|
| | Year 1 Man Years | Year 2 Man Years | Year 3 Man Years | Year 4 Man Years | Year 5 Man Years | Total Man Years |
| Carpenter/415 | 35 | 83 | 48 | 59 | 12 | 237 |
| Cement Cons. Fin./421 | 6 | 14 | 20 | 14 | 6 | 60 |
| Iron Worker/550 | 42 | 62 | 52 | 42 | 10 | 208 |
| Laborer/751 | 56 | 70 | 79 | 68 | 28 | 301 |
| Millwright/502 | 2 | 7 | 4 | 6 | 1 | 20 |
| Exc. Equip. Op./412 | 111 | 55 | 34 | 11 | 11 | 222 |
| Pipefitter/522 | 37 | 148 | 260 | 186 | 111 | 742 |
| Electrician/430 | 35 | 82 | 78 | 106 | 53 | 354 |
| Asb. Worker | 8 | 33 | 33 | 49 | 25 | 148 |
| Painter/510 | 0 | 4 | 30 | 37 | 4 | 75 |
| Sheet Metal Worker/535 | 15 | 44 | 74 | 119 | 44 | 296 |
| Mason/410 | 2 | 7 | 5 | 0 | 0 | 14 |
| Teamster/715 | 14 | 24 | 14 | 7 | 10 | 69 |
| Drafting/152 | 60 | 16 | 4 | 0 | 0 | 80 |
| Surveying/161 | 9 | 0 | 0 | 0 | 0 | 9 |
| Boilermaker/404 | 44 | 56 | 47 | 53 | 22 | 222 |
| Welder/228 | 20 | 48 | 44 | 36 | 8 | 156 |
| Engineering/010 | 13 | 53 | 43 | 165 | 7 | 281 |
| Engineering/011 | 13 | 93 | 75 | 289 | 12 | 482 |
| Engineering/012 | 11 | 53 | 43 | 165 | 7 | 279 |
| Engineering/014 | 5 | 30 | 25 | 94 | 4 | 158 |
| Engineering/021 | 5 | 0 | 0 | 0 | 0 | 5 |
| Engineering/002 | 11 | 0 | 0 | 0 | 0 | 11 |
| **Total of All Occupations** | **554** | **982** | **1,012** | **1,506** | **375** | **4,429** |

SOURCE: *Task Force Report: Synthetic Fuels From Coal*, Project Independence Program, Federal Agenergy Administration, Washington, D.C.

## TABLE IV-4

### Manpower for Pipeline (High-BTU) Gas Plant Construction

Energy Resource: Coal
Facility Type: Pipeline Gas

**Unit Capacity: 250 x $10^6$ scfd**

**Years to On-Line Production**

| Occupational Groups/ SIC Code | Year 1 Man Years | Year 2 Man Years | Year 3 Man Years | Year 4 Man Years | Year 5 Man Years | Total Man Years |
|---|---|---|---|---|---|---|
| Carpenter/415 | 0 | 0 | 48 | 106 | 12 | 166 |
| Cement/Cons. Fin./421 | 0 | 0 | 11 | 26 | 0 | 37 |
| Iron Worker/550 | 0 | 0 | 32 | 91 | 20 | 143 |
| Laborer/751 | 0 | 0 | 34 | 120 | 43 | 197 |
| Millwright/502 | 0 | 0 | 2 | 8 | 4 | 14 |
| Exc. Equip. Op./412 | 0 | 0 | 30 | 80 | 43 | 153 |
| Pipefitter/522 | 0 | 0 | 41 | 413 | 269 | 723 |
| Electrician/430 | 0 | 0 | 11 | 138 | 108 | 257 |
| Asb. Worker | 0 | 0 | 5 | 66 | 43 | 114 |
| Painter/510 | 0 | 0 | 3 | 19 | 28 | 50 |
| Sheet Metal Worker/535 | 0 | 0 | 1 | 5 | 3 | 9 |
| Mason/410 | 0 | 0 | 1 | 2 | 0 | 3 |
| Teamster/715 | 0 | 0 | 24 | 20 | 4 | 48 |
| Drafting/152 | 0 | 50 | 0 | 0 | 0 | 50 |
| Surveying/161 | 0 | 15 | 0 | 0 | 0 | 15 |
| Boilermaker/404 | 0 | 0 | 21 | 81 | 51 | 153 |
| Welder/228 | 0 | 0 | 25 | 80 | 15 | 120 |
| Engineering/010 | 0 | 28 | 0 | 4 | 4 | 36 |
| Engineering/011 | 0 | 37 | 8 | 17 | 7 | 69 |
| Engineering/012 | 0 | 28 | 0 | 5 | 3 | 36 |
| Engineering/014 | 0 | 28 | 0 | 5 | 5 | 38 |
| Engineering/021 | 0 | 10 | 0 | 4 | 0 | 14 |
| Engineering/002 | 0 | 56 | 0 | 0 | 0 | 56 |
| **Total of All Occupations** | **0** | **252** | **297** | **1,290** | **662** | **2,501** |

SOURCE: *Task Force Report: Synthetic Fuels From Coal*, Project Independence Report, Federal Energy Administration, Washington, D.C.

TABLE IV-5

Manpower for Liquid Fuel Plant Construction

Energy Resource: Coal
Facility Type: Liquid Fuel
Unit Capacity: 500 x $10^6$ scf/day gas—1 x $10^5$ bbl. liquid fuel

Years to On-Line Production

| Occupational Groups/ SIC Code | Year 1 Man Years | Year 2 Man Years | Year 3 Man Years | Year 4 Man Years | Year 5 Man Years | Total Man Years |
|---|---|---|---|---|---|---|
| Carpenter/415 | 35 | 81 | 46 | 58 | 12 | 232 |
| Cement/Cons. Fin./421 | 6 | 13 | 19 | 14 | 6 | 58 |
| Iron Workers/550 | 41 | 61 | 59 | 41 | 10 | 212 |
| Laborer/751 | 54 | 69 | 77 | 66 | 27 | 293 |
| Millwright/502 | 2 | 7 | 4 | 6 | 1 | 20 |
| Exc. Equip. Op./412 | 108 | 54 | 33 | 11 | 11 | 217 |
| Pipefitter/522 | 36 | 145 | 253 | 181 | 108 | 723 |
| Electrician/430 | 35 | 80 | 76 | 184 | 52 | 427 |
| Asb. Worker | 8 | 32 | 32 | 48 | 24 | 144 |
| Painter/510 | 0 | 4 | 29 | 36 | 4 | 73 |
| Sheet Metal Worker/535 | 14 | 44 | 72 | 116 | 43 | 289 |
| Mason/410 | 2 | 7 | 5 | 0 | 0 | 14 |
| Teamster/715 | 13 | 23 | 13 | 7 | 10 | 66 |
| Drafting/152 | 58 | 15 | 4 | 0 | 0 | 77 |
| Surveying/161 | 9 | 0 | 0 | 0 | 0 | 9 |
| Boilermaker/404 | 43 | 54 | 46 | 52 | 22 | 217 |
| Welder/228 | 19 | 46 | 42 | 35 | 8 | 150 |
| Engineering/010 | 10 | 60 | 30 | 20 | 10 | 130 |
| Engineering/011 | 20 | 80 | 70 | 20 | 10 | 200 |
| Engineering/012 | 10 | 50 | 50 | 20 | 10 | 140 |
| Engineering/014 | 10 | 60 | 50 | 20 | 0 | 140 |
| Engineering/021 | 0 | 20 | 20 | 10 | 0 | 50 |
| Engineering/002 | 30 | 120 | 100 | 30 | 0 | 280 |
| **Total of All Occupations** | **573** | **1,125** | **1,130** | **975** | **378** | **4,181** |

**SOURCE:** *Task Force Report: Synthetic Fuels From Coal*, Project Independence Report, Federal Energy Administration, Washington, D.C.

It should be noted that the job opportunities listed in the tables on the previous pages are for highly skilled laborers. At present, there are few facilities for large-scale training of skilled laborers in these categories in Montana. If construction and operation of energy conversion facilities are to provide job opportunities for the present labor force, it would appear that considerable training and retraining of the Montana labor force will be necessary. At present, training for such apprenticeable occupations in Montana is on a small scale. Further, few Montana laborers in these categories are unemployed.[12]

## MARKET CONCERNS

The *Montana Economic Study*,[13] published in 1970, presents a detailed, well-reasoned analysis of the Montana economy. The factors influencing the state's economy, as identified in that publication, are relevant still. Among these factors are distance from major markets and absence of significant in-state markets, lack of diversity in the state's economy, infrastructure inadequacies and, as above, lack of a large, diverse pool of skilled laborers. These factors militate against the siting in Montana of many types of large-sized industrial enterprises, unless the product of those industries is such that the expense of its transportation to markets is a minor part of its price, or the product can be produced nowhere else.

[12]Personal communications with Curt Warner, Employment Services Bureau, Montana Department of Labor and Industry, December 1975.

[13]*Montana Economic Study*, Bureau of Business and Economic Research, University of Montana, December 1970.

Energy development, whether of mines or of conversion facilities, is subject to the same market concerns. According to the *Montana University Coal Demand Study*,[14] the following factors also will play a significant role in Northern Great Plains and Montana energy development.

The market for Northern Great Plains (and Montana) will be very sensitive to air pollution control regulations. If federal regulations require flue gas desulfurization and/or low sulfur coal for both new and existing coal-fired electric generating plants, an expanded 21-state market for Northern Great Plains coal will exist. This is due to the cost of the equipment and processes that will be required—in this case, "expensive" western coal will become more attractive. If lesser standards and less expensive equipment are allowed, the market for Northern Great Plains coal is expected to contract to a 13-state market.

Projections of large-scale coal development in Montana (150-300 million tons per year) will require (1) a continuation of the historic growth rate in electric energy consumption, and (2) considerable conversion of coal to synthetic natural gas, liquid hydrocarbons, petrochemicals and fertilizer. (Price sensitive projections indicate that the future growth in electric power consumption will not follow historic trends. Further, technological problems are hindering the synthetic fuels industry.)

It also should be remembered that extensive coal reserves underlie many eastern states. There are strippable, low sulfur eastern coals of higher BTU value than that of western coal. Most deep mineable eastern coals far surpass the BTU values of western coals. The demand for western coal could decrease if the deep mining industry adopts more efficient mining techniques (as are used in Europe) or if coal solvent refining processes become practical.

[14]Silverman, *et. al., Montana University Coal Demand Study*, 1976.

## TECHNOLOGICAL CONSTRAINTS

The public has been told that the solution to the nation's energy crisis lies in readily available, proven coal conversion and nuclear energy technology. Government and industry spokesmen claim that the technology to develop synthetic fuels from coal is an accomplished fact and that synthetic fuel plants have been productive for years. Such statements are true only in part. Low and medium BTU gasification of coal has been conducted on a commercial scale for decades, here and abroad. Laboratory demonstration of high BTU gasification has been accomplished. However, to date, no large-scale, commercially feasible, high BTU gasification plant has been operated for any sustained period of time. It is a long step from laboratory demonstration of a process to the construction and operation of a full-scale, commercial, money-making application of that process. No planned high BTU coal gasification plant in the United States is on schedule. All such proposed plants have been either indefinitely postponed or terminated.

Recent indications suggest that not only are technological problems hindering development of high BTU gasification plants, but also that any product will be very expensive. The *Montana University Coal Demand Study* concludes that high BTU coal gasification will not be viable unless it is heavily subsidized. Dr. Richard Stroup, an economist at MSU, has indicated that high BTU synthetic gas may cost, conservatively, $3.88 per thousand cubic feet. More informal estimates place the synthetic gas price nearer $5.00 per mcf. Current prices of Canadian natural gas have reached $1.60 per mcf. and are slated to reach $2.00 per mcf. next year. The price of synthetic gas, then, is estimated at a level nearly twice that of the expected price of Canadian gas — the highest priced natural gas available. Regarding liquid synthetic fuels, *Business Week* (August 11, 1975) reports that such fuels now are estimated to cost from $14 to $24 per barrel. This price is well above current world oil prices. In the same article, industry spokesmen indicated that proposed federal government subsidies will pose not only the possibility of significant losses of government funds, but also will be of little help to the industry.

Synthetic fuels processes also are plagued with difficulties in on-site construction technologies. The Project Independence report of the Synfuels Task Force has cited problems in field construction technology as a potential and major impediment to the synfuels industry. Problems also have arisen in the transportation of plant components from factory to construction site. The size of some components may exceed the capacity of existing transportation systems.

The energy efficiency of some synthetic fuels processes is a further cause of concern. In-situ technologies, for example, operate at very low thermal efficiencies, losing on the average more than 80 percent of the heat value of the resource in question. Of the fossil fuel "exotics", only MHD offers a reasonable probability of high efficiences at moderate cost, according to Dr. Jerry Plunkett, Director of the Montana Energy and MHD Research and Development Institute. Plunkett maintains that the problems in synfuels process technologies soon will be resolved, but that in the context of economic and environmental costs and energy efficiences, there is little to recommend those process.[15]

Technological concerns exist regarding direct burning of Montana and other coals. Various coal characteristics (such as caking, moisture content, ash content, ash fusion temperature and others) determine the nature of the combustion chamber that will be required to burn the coal efficiently. In short, boilers are practically custom built for certain coals. Coals different from those for which a particular boiler was built may not perform properly when fired. As a result, once a boiler is built, coal to fuel it must be carefully chosen, or considerable retrofitting of boiler components will be required. Consequently, Montana coals may be unsuitable for some boilers and, hence, may be less competitive than other coals.

[15]Personal communications with Dr. Jerry Plunkett, Montana Energy and MHD Research and Development Institute, December 1975.

Nuclear fission technology has received increasing concern from citizen groups and the scientific community. The brunt of this concern is focused on reactor safety and the disposal of reactor wastes. Breeder reactor technology (an anticipated solution to both power generation and radioactive fuel shortages) has experienced setbacks of late. The most enthusiastic proponents of nuclear fusion do not expect commercial application of that process in less than 40 to 50 years. Finally, public utilities have been postponing planned construction of nuclear facilities, due to increased costs and market uncertainties.

## POLICY AND LAW

National and state laws and policies pose definite limits to energy industrialization. Law and policy are subject to direct change in intent through legislative activity and to indirect change by implementation or interpretation. These changes, sooner or later, are subject to public review, influence and consent. In this context, the desires of special interests are subject to widespread public examination and change occurs (theoretically, at least) only when the majority of those affected either approve of or assent to it. Changes in policies and laws affecting energy industrialization will be a long process. As a consequence, constraints on energy development imposed by law and policy must be given serious consideration.

The National Environmental Policy Act is an important limit to energy development. That statute specifically requires a comprehensive, public review of significant federal actions and of alternatives to those actions. Costs and benefits of proposals are to be clearly discussed. Federal actions are to proceed only if they can be shown to be of net benefit. Failure to comply with the requirements of this act has led to numerous court cases and to the termination of several major projects.

The requirements of the Clean Air Act also pose a significant potential limit to energy development. Depending upon federal and state definitions of air quality regions and air quality standards (which also are subject to public review), certain development proposals may be directly or indirectly eliminated at certain sites (direct elimination due to inability to comply with air quality standards, indirect elimination due to high cost of compliance). Similar comments apply to other federal statutes, such as the Water Pollution Control Act, the Wilderness Act, the Endangered Species Act and so forth.

A number of Montana statutes is relevant to resource and energy development, as is Article IX of the Montana Constitution. Some 11 Montana statutes pertain directly to regulation of strip mining and energy conversion facility siting. Many of these statutes contain mandamus provisions guaranteeing public access to state government decisions through judicial recourse. These statutes specifically require consideration of public need and environmental and social compatibility (Major Facility Siting Act), successful land reclamation (mined land reclamation statutes), maintenance of air and water quality, payment of taxes and fees sufficient to meet development-induced impacts, and specification of appropriate uses of water resources (Water Use Act). State government specifically is forbidden to allow certain development activities unless these requirements are met. If state government is lax in enforcement of these statutes, it is liable to suit by aggrieved parties.

Policies define the philosophy and procedure by which actions are to be taken by an organization. Although lacking the power of specific legal sanctions, policies impose specific effects upon the workings of government and, hence, upon the various publics affected by government. The explicit Department of the Interior policy imposing a moratorium upon additional leasing of federal coal reserves is an example. That policy had been in effect for four years despite the efforts of the energy industries to negate it. Other more informal policies also can affect development activities by influencing the vigor and competence displayed in execution of laws. The Department of the Interior now is a defendant in several cases before various federal courts. In each instance, Interior is alleged to have violated the letter and/or intent of several federal laws in various proposed federal leasing policies and plans. In addition, Interior has been chided for laxity in enforcing the performance and environmental control standards of statutes regulating the leasing of federal minerals.

Several philosophical policies are implicit in Montana statutes governing resource and energy development activities. Examples of Montana's constitutional and legislative policies are as follows:

(1) The people of the state are entitled to a clean and healthful environment. This right is explicitly extended to future generations (q.v., Montana Constitution, Article IX; Montana Environmental Policy Act; Montana Strip and Underground Mine Reclamation Act; Montana Major Facility Siting Act; Resource Indemnity Trust Fund).

(2) The environmental life support system must be protected (q.v., Montana Constitution; Montana Strip and Underground Mine Reclamation Act and amendments; Montana Environmental Policy Act; Montana Major Facility Siting Act).

(3) The present generation is charged with the explicit responsibility of serving as trustee of the state's natural resources for succeeding generations (q.v., Montana Environmental Policy Act; Renewable Resource Development Act; Strip Mined Coal Conservation Act).

(4) Natural resources, renewable and nonrenewable, are to be used wisely, for the maximum benefit of all citizens. Such resources are not to be wasted, nor is their development to be conducted in a manner deleterious to the ecosystem (q.v., Montana Constitution; Montana

Environmental Policy Act; Montana Strip and Underground Mine Reclamation Act and amendments; Strip Mined Coal Conservation Act; Montana Major Facility Siting Act; Montana Water Use Act; Clean Air Act of Montana; Renewable Resource Development Act).

(5) The government of Montana is to take an active role in insuring that ecosystem and natural resource values are protected and used wisely (q.v., Montana Constitution, House Bill 453 of the 1975 Legislative Session and all statutes cited previously).

### PUBLIC DEMAND AND ATTITUDES

The nation's citizens will play a significant role in determining the ultimate course taken in resolution of the energy crisis. Current federal plans propose supporting various energy technologies with tax dollars. Increasing scarcity of energy reserves and corresponding increases in the price of energy supplies directly affect the public's willingness to consume energy. Although not all energy consumption is immediately discretionary, increased prices of energy supplies are expected to decrease energy demands. Beyond the immediate dollar impacts of increased energy prices lie increased energy costs—environmental, health and social costs imposed by energy development technologies and activities. As additional information becomes available quantifying and exploring alternatives to those costs, one should expect increased public opposition to the causes of them. Such opposition would be expected to occur in the political arena as well as in the marketplace.

Survey and ethnographic research in Montana has revealed considerable public interest in, and concern with, energy development issues. Many of those surveyed have indicated their awareness that energy industrialization can impose costs as well as provide income and tax revenue benefits. Montana citizens surveyed have indicated that they will support energy industrialization only if it can be shown that such activities will not significantly affect environmental quality and other amenities.[16] In short, growth is desired, but only if such growth will not impinge upon the quality of the "Montana life style". Respondents have indicated that increased incomes will not substitute for unpolluted open spaces, accessible recreational resources and an unhurried pace of life. Respondents also have indicated that high population densities are unacceptable. Although "controlled" energy industrialization was acceptable to many surveyed (given compliance with laws and values), in most cases the respondents indicated that such activities should occur in some other area of the state, rather than in their area of residence. To the degree that energy development activities are inconsistent with public desires, opposition to such activities should be expected to increase.

[16]Ethnographic and survey research conducted by Gold, Jobes and Parsons, Faulkner and Fitzpatrick. Specific references furnished on request.

## V. TECHNOLOGICAL ALTERNATIVES AVAILABLE TO MONTANA

Increasing prices and dwindling supplies of finite petroleum and natural gas reserves pose significant problems for Montana energy consumers. There can be little doubt that both resources will be very near depletion in the foreseeable future. Canadian policy decisions will result in the elimination of approximately 55 percent of the natural gas consumed in Montana by the early 1980's. Montana petroleum refineries also are dependent upon Canadian imports for one-third of their crude stock (see Chapter II). Montana government must continue and expand its consideration of alternative energy sources and technologies in light of these impending shortages.

This chapter has been written to provide a brief identification of the range of energy sources and technological alternatives available for consideration.

### FOSSIL FUEL ALTERNATIVES

State government must undertake an effort to determine the minimum energy needs of those sectors of Montana that consume natural gas and petroleum. This will be a difficult task, in part, because energy needs will vary as a function of different "alternative futures" the state may pursue. However, an estimate of the energy required to maintain the status quo could and should be developed.

The state should determine the degree to which it can influence the exploration for and development of petroleum and natural gas reserves to meet identified state needs. The state also must investigate the alternative means by which such influence may be accomplished. At present, Montana has limited information and no influence over the destination and use of petroleum or natural gas reserves that are developed within the state. Apparently, even the extent of these reserves is an unknown quantity. It may be possible for Montana to require that a portion of any developed resources be reserved for use within Montana. If it is impossible to attract private developers under such conditions, the state may be forced to consider developing those resources itself on a contract basis.

The state may be able to enter into agreements with energy producers in other states and with the proponents of new petroleum and natural gas pipelines. Although such arrangements normally are left to the private sector, the state may be required to enter this arena to assure that minimum energy supplies are available to its citizens. Perhaps the public utility districts prevalent in other states could serve as models and as a precedent for such state activities.

Montana government must commit resources to the development of specific and feasible plans and programs to conserve energy, at all levels. Information gained from the activities mentioned above should provide estimates of the amounts and types of energy Montana can acquire and will require in the future. With this as a baseline, plans and programs could be designed to maximize the life and benefits of energy reserves. The consumptive uses and methods of use of natural gas and petroleum products should be carefully examined. It is almost certain that the efficiency of such methods and uses can be improved from the level of the largest consumer to that of the household. Planning and programming efforts should closely examine all the alternative means available to increase the efficiency and reduce the waste in energy consumption, whether through simple insulation or through the incorporation of more sophisticated equipment and processes.

Recognizing the finite nature of natural gas and petroleum reserves, the Governor organized the Montana Task Force on Gasification and charged it with investigating the feasibility of gasifying Montana coal to produce high BTU synthetic gas. This technological alternative is the only one being considered by that group. Other alternatives exist and should be examined.

Among these alternatives are low and medium BTU coal gasification processes. These processes are intermediate in the production of high BTU gas and have been available on a commercial scale for many decades. The "town gas" of the early 1900's was gas produced from coal. Although not as safe or as high in heat content as natural gas, this gas could be put to industrial and institutional use as a natural gas substitute, thereby freeing more natural gas reserves for domestic use. An investigation of the feasibility of industrial use of such gas in comparison to the projected costs of high BTU syngas should be initiated immediately. State government should examine this alternative for use at its larger institutional facilities. In this context, the economic and energy efficiency of transporting such gas should be examined. At present, it appears that the low and medium BTU gas alternatives require load center generation if efficiency criteria are to be met.

The state also should investigate alternative mechanisms of supporting the development of facilities to generate low and medium BTU gas as a natural gas substitute. Development could be left to the private sector or government could develop such gas in partnership with the private sector. If it appears necessary that government enter this area to assure the production of this energy source, several alternatives could be explored. State government could contract with the private sector for production of such gas. State government also could provide investment capital, as has been suggested for high BTU syngas production. The larger cities and towns in Montana could pursue this avenue as well (with state aid if necessary) or could form public utility districts, assuming the passage of favorable legislation.

The minimum size of low and medium BTU gas facilities bears examination using economic, energy efficiency and environmental criteria. It appears that the use of this gas on a small scale will not be feasible using those criteria, at least until natural gas supplies are depleted and other alternatives are found wanting. Other synthetic fuel alternatives also should be examined. Although synfuel technologies do not yet appear too promising from the standpoints of energy efficiency and cost of the final product, technological improvements and depletion of natural gas and oil may make them more attractive. Developments in the areas of synthetic crude, methanol and fertilizers should be monitored closely.

Magnetohydrodynamics (MHD), of all the "exotic" fossil fuel-based energy technologies, appears to offer the greatest possibility of feasible application. The MHD process generates electricity by passing extremely hot, ionized gases over conductors, in the presence of a strong magnetic field. The overall thermal efficiency of the process is superior to that of conventional thermal electric plants when applied in combined cycle (a steam turbine attached to the MHD chamber, utilizing exhaust gases to generate additional electricity). MHD plants are expected to achieve a thermal efficiency of 50 percent in such applications, compared to the 35-40 percent thermal efficiency of the best conventional or nuclear power plants. With more sophisticated design, MHD efficiency could reach 60 percent. The MHD process also offers significant environmental advantages in that sulfur oxide emissions can be eliminated and nitrogen oxide emissions minimized.[17] Dr. Jerry Plunkett, who leads the MHD project in Montana, has released news of the accomplishment of two important milestones in MHD research. First, AVCO Inc., pioneers in MHD technology in the United States, has achieved continuous operation of an MHD channel for 98 hours, under conditions comparable to that of a commercial application. Second, a joint Russian and United States project has provided confirmation of several hypotheses regarding the MHD process. According to Plunkett, this indicates that research has provided an adequate understanding of the MHD process and that attention now can be directed toward development of the hardware necessary to commercial application of MHD.

Montana is fortunate to have been chosen as the site for a federally funded MHD test facility. Located in Butte, the Montana Energy and MHD Research and Development Institute (MEMRDI) is to conduct operations in three phases. The initial phase, just underway, is the construction of a Component Development and Integration Facility (CDIF), a pure research facility designed to test various components of the MHD process. The second stage of the project will entail the construction of an Engineering Test Facility (ETF). The ETF will be a small pilot plant constructed to test the total MHD process in combined cycle operation. This plant is expected to generate 125-140 megawatts of electricity, which will be fed into existing commercial power systems. The ETF is expected to be

[17] "Magnetohydrodynamics Power—More Efficient Use of Coal", American Academy for the Advancement of Science.

completely separate from the CDIF and may be erected at a different site. The final stage of the project will be the construction of a commercial demonstration plant of approximately 500 megawatt capacity. The legal staff of the Department of Natural Resources and Conservation have concluded that the MHD project is exempt from Montana's Major Facility Siting Act.[18]

The alternative of direct burning of coal as a natural gas and oil substitute should be examined in detail. Careful studies of the feasibility of using coal as fuel in the major industrial energy-consuming plants should be undertaken by the state. The Montana University System has initiated a study of this alternative for campus use. A similar study should be begun for all state facilities. An informal survey of industrial natural gas consumers has revealed that some industrial plants will be converted to coal in place of natural gas in the near future. This survey should be expanded to include competent research of the economic and technological feasibility of such conversions in the major industrial processes in Montana. Domestic uses of coal also must be considered, particularly in light of recent improvements in small-scale furnaces for home or building use.

Finally, an analysis of the market for electricity generated from coal must be initiated. The analysis would consider that market in light of increased costs of electricity from thermal sources, in comparison to other energy sources that could be available to large and small energy consumers. The feasibility of slave generating plants for larger industrial uses also should be examined. Electricity appears to be a favorable alternative to other energy sources, at least for the short term. For this reason, any comparison of this and other alternatives should consider the relative energy, environmental, social and economic costs of each alternative over the long term. The comparison should include an analysis of the degree to which one alternative forecloses the pursuit of others.

[18]*Memorandum of Law, Re: Proposed MHD Demonstration Project and the Major Facility Siting Act, State Jurisdiction*, December 5, 1975.

## NUCLEAR ENERGY

Persistent rumors have it that various nuclear power proponents have designated sites within Montana for nuclear generating plants. Other rumors, less persistent, suggest that Montana will be the site of a uranium enrichment facility. Although such rumors have been extremely difficult to substantiate, Montana should begin to examine the nuclear power issue in a thorough and consistent manner.

Federal and industry plans indicate that nuclear power is to play a heavy role in the nation's energy economy in the next century. Despite these plans, public and scientific resistance to the nuclear power concept is increasing. This resistance centers around such issues as reactor safety and maintenance, thermal discharges, disposal of radioactive wastes, and susceptibility of reactors or fuel and waste sites to terrorist attack. National concern also is centered upon the availability of nuclear fuel, since uranium reserves are nearly depleted and the breeder reactor has yet to be perfected.

Montana government should investigate the costs and benefits of nuclear power and become informed of the issues surrounding the nuclear controversy. An identification of likely sites for nuclear plant construction also would be of interest. Although the probability of a nuclear accident is claimed by proponents to be low, the consequences of such an accident could be disastrous. The Montana public and their government should be prepared to cope with this issue.

## RENEWABLE RESOURCE ALTERNATIVES

Montana has greater opportunities to explore innovative energy technologies based upon renewable resources, and make practical applications of them, than many other states. In some areas, water supplies are ample for small-scale geneation of hydroelectric power. Wind and solar energy potentials also appear to be high. The timber and wood products industries in Montana produce "wastes" that could be used as fuel for direct burning or as feedstock for pyrolysis or methane and methanol production processes. Livestock, human and municipal wastes also are an energy resource of significant potential.

Proponents of conventional power sources argue that none of the "exotic" technologies have great potential as replacements for large-scale hydro and thermal electric energy production. This may be true in large and congested urban areas or in heavily energy intensive industrial processes. However, that argument is less convincing when applied to rural, sparsely populated areas or to small communities favorably located with respect to water, wind, solar or other resources. Even in congested areas, renewable energy resources could provide a useful supplement to or substitute for conventional power sources.

Dr. William Heronemus, one of the nation's foremost authorities on and proponents of wind power, has stated his conviction that Montana could be a net energy exporter based on wind power potential alone. Heronemus has outlined a procedure by which Montana might pursue and develop its wind resources. This procedure entails quantifying the wind power resources of Montana at various sites and determining the actual and potential energy market in various areas. Given this information, wind conversion systems could be designed to meet either steady or supplemental loads. John Obermeier, an engineering student at Montana State University, has been compiling data on wind power potential at various sites in Montana.[19] His data should be elaborated and a good statewide data base generated.

Interest in solar power has increased dramatically in the

[19]Personal communications with the Alternative Energy Resources Organization, Billings, Montana, November and December, 1975.

last two years. Proponents of conventional power sources have insisted that economical substitution of solar-generated electricity for other sources of electricity is far in the future. Whether or not this is the case, solar irradiation can provide a substantial portion of the energy budget for space and water heating, thus freeing gas, oil and electricity for more critical, less flexible uses. According to the Alternative Energy Resources Organization, several houses and other buildings in Montana have been designed to rely on solar irradiation for space and water heating. Several firms within the nation have products on the market that would allow many homeowners to heat their houses almost entirely with the sun's rays, at economical prices.

Detailed solar insolation data in Montana is spotty. Although solar power potential appears great in Montana, support of solar technologies would be enhanced if more detailed information were available. State government should encourage and support a thorough data collection program to gather more comprehensive solar radiation values on a statewide basis. Given solar data, and a study of available solar technologies, the public and private sectors would be able to better allocate resources in support of solar energy programs.

Hydroelectric power has been the mainstay of the energy industry in our region. All current hydro developments are of large scale, owned either by the federal government or by the energy industry. According to Bill Delp, an entrepreneur developing small-scale applications of hydro technology, Montana has great potential for individual household and small community hydro projects. A number of small projects could reduce demand on existing large-scale projects, at far lower environmental and economic cost.

As is the case with most other energy resources, Montana government has no data indicating the potential for small-scale hydro projects within the state. Before such projects can be considered feasible alternatives, an effort must be made to determine the potential for small projects in various areas of the state, by size of project. With information of this sort, public and private groups might be encouraged to pursue small hydro projects as a feasible alternative to purchasing power from larger sources. Although initial costs of small projects will be higher than the alternative of purchasing power, the smaller project should be cheaper in the long run, when the economic and environmental costs of demand-induced expansion of large facilities are considered.

Animal, human and wood wastes are an immense and nearly untapped resource in Montana. Some wood wastes now are used in Montana's wood products industry, but still more wood waste is left on the forest floor or burned as slash or mill wastes. The BTU content of wood is quite high, and processed wood wastes are good resources for pyrolytic or anaerobic digestion processes, producing methanol, methane and other by-products. Human and livestock "wastes" are another source of feedstock for the production of methane and sanitary fertilizer. These resources now are largely processed, burned and buried or flushed into the state's streams, creating significant land use and water quality problems. In other nations, human and animal wastes have been used as an energy resource and as a renewable source of fertilizer. Such uses are limited in the United States. Human wastes are used as an energy source in some sewage treatment facilities, the process methane being used to heat the waste digesting system. Some authorities have claimed that sewage treatment plants could provide methane gas in small but usable quantities. Livestock wastes in Montana also could be consumed to produce usable quantities of methane in areas near feedlots. This gas could serve as a supplement to purchased gas in more rural areas.

Municipal wastes represent still another untapped resource in Montana. The BTU content of the municipal wastes of Montana cities has been estimated to be about 5,000 BTU per pound, more than one-half the heat content of Montana coals. In addition, the non-combustible portions of these wastes represent a "mineable" source of recoverable materials, as several cities in the nation have demonstrated. According to a study prepared for the Department of Health and Environmental Sciences, approximately 590,000 tons of municipal waste were generated in Montana in 1975. This quantity is expected to increase to about 870,000 tons per year by 1990. The study also concluded that approximately 78 percent of all such wastes could be processed at a resource recovery facility.[20] The state should explore further the feasibility of using municipal wastes as a supplemental energy source at various sites in Montana, particularly in the larger cities.

Finally, Montana is reputed to have significant geothermal resource potential. Current geothermal energy technology, in most applications, is limited to the use of dry steam, of which there appears to be little in Montana. More research to quantify and qualify Montana's geothermal resources is needed. Discoveries to date have been disappointing. Geothermal resources in the form of hot springs could be used by individuals for space heating but the potential for large-scale geothermal development in Montana does not appear too promising at this time.

Interest in the use of renewable energy resources is growing in the state and the nation. Several privte profit and non-profit organizations within Montana are compiling information on renewable resource technologies and are developing small-scale applications of those technologies. At present, formal Montana government activity in this area is limited to execution of Senate Bill 86, providing a fund for research, development and demonstration of alternative energy sources. State government should expand its activities in this area to take advantage of public interest and to clarify the issues surrounding the development of renewable energy resources.

The public appears to be placing increasing faith in the eventual development of renewable energy resources. Before these resources can be considered a reliable source

[20] *Population, Employment and Waste Generation Report for State of Montana Solid Waste Management and Resource Recovery Study*, Henningson, Durham and Richardson, December 1975.

of consumable energy, some detailed quantification of their limits will be necessary. Careful analysis of the limits of these resources and of renewable resource conversion technologies is essential to prevent misjudgment and premature reliance on them. As nonrenewable resources near depletion, their use will become increasingly expensive. This will pave the way for increased use of renewable resources and related technologies.

Until the nation accepts the reality of depletion of nonrenewables and of increasing costs of energy, the promotion of renewable resource energy on a grand scale could damage the credibility of that alternative. In the interim, renewable energy supplies do represent a very feasible supplement to conventional energy sources, particularly in rural areas. The state should promote or engage in research to develop multiple component renewable energy alternatives for use by individual homeowners, small businesses and small communities. At the same time, the state should begin gathering specific data indicating renewable energy resource potentials and limits, statewide. This latter activity could be conducted in conjunction with necessary state efforts to better quantify nonrenewable energy resources and their development.

### CONSERVATION

Wiser use of all resources must become a cardinal point of the American and the Montana life styles. Many highly industrialized, highly developed nations use less than one-half the energy per capita consumed in the United States (in 1972—Sweden 49%; West Germany 46%; United Kingdom 46%; Japan 28%; Denmark 48%; Switzerland 31%; New Zealand 25%; the whole world 17%).[21] A quality life style does not have to be defined as the squandering of material and energy resources. A quality life style, over time, will demand wise use of those resources.

Conservation will require both individual and institutional commitment and initiative. Individuals must begin to think before consuming and must moderate their demands for energy consumptive goods and services. We must attempt to make what we consume go farther and last longer. Institutions must examine their policies, rules and regulations with an eye to identifying and correcting those which promote wasteful consumption or inhibit conservation of resources. Industry must examine its processes to determine where energy and/or materials savings are possible. The costs of these activities will be repaid in the long run, as energy and material resources approach depletion.

State government should begin a review of codes, rules and regulations pertinent to energy development, use and conservation. Requirements of law or policy that interfere with conservation of energy should be identified and corrected. Montana government also must begin to develop reasoned plans and policies of energy conservation for government operations. Finally, in cooperation with the public, the Legislature and industry, state government should begin to design statewide programs for energy conservation. These programs must explore alternative means of energy consumption that will extract the maximum benefit from each unit of energy consumed.

[21]Personal communication with the Alternative Energy Resources Organization, December 5, 1975.

## VI. SOME EFFECTS OF ENERGY DEVELOPMENT

This chapter provides a brief introduction to some major effects of industrial development. Part of the material presented is from an earlier publication of the Montana Energy Advisory Council (MEAC).[22] More detailed information is available from MEAC.

### SELECTED PROJECTIONS OF IMPACTS RELATED TO ENERGY DEVELOPMENT

The impact of industrial development is usually portrayed in terms of population growth and increased employment opportunities, incomes and tax revenues. Presented below are selected population, employment, income and revenue projections made for coal development in Montana. The original source of these projections is identified at the bottom of each table. It must be emphasized that projections of events are simply that—they are educated guesses based upon certain mathematical manipulations and qualifying assumptions. They are not infallible and inviolable forecasts of the future. If the assumptions underlying the projections are invalid, if technology should suddenly change, or if energy demands have been miscalculated, the projections may be quite inaccurate. Nevertheless, projections can serve as a useful tool in catching a glimpse of what the future may bring.

[22]*Coal Development Information Packet, Supplement I*, Montana Energy Advisory Council, July 1975. *See also* Gold, Raymond L., *A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming*, Institute for Social Science Research, University of Montana, June 1974. *Also* personal communications with John Fitzpatrick, Raymond L. Gold, Clarence C. Gordon, Frank Montibeller.

## POPULATION PROJECTIONS FOR COAL DEVELOPMENT AREAS

Table VI-1 presents the total population projected to occur in the coal regions of Montana under three coal development profiles (CDPs). The coal development profiles are defined as follows:

CDP I: A rate of coal production sufficient to meet contractual agreements and regional increases in the demand for coal.

CDP II: A rate of coal production for export, in-region power generation, electrical export, and synthetic natural gas production.

CDP III: A rate of coal production based upon the maximum contribution that Northern Great Plains coal might reasonably be expected to make in alleviating shortages in the supply of imported oil and gas and domestic nuclear generation.

Coal development in Montana under these profiles would by 1985, equal:

CDP I: 39 million tons per year.

CDP II: 75 million tons per year.

CDP III: 153 million tons per year.

It should be noted that Montana coal production will exceed the CDP I, 1985 level.

Tables VI-1, VI-2 and VI-4 indicate the population projections made for the coal development area of Eastern Montana under various development assumptions. Note that the projected population changes are enormous and that the areas in which they are to occur were sparsely populated in 1970.

**TABLE VI-1**

**Total Population Projections**
**CDPs I, II, III — 1980, 1985, 2000**

| | | Principal Impact Area* | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | State Total 1970 | 1970 | 1980 | % Chg. 70-80 | 1985 | % Chg. 80-85 | 2000 | % Chg. 1985-2000 | % Chg. 1970-2000 |
| CDP I | 694,000 | 123,000 | 142,000 | 15.4 | 135,000 | 5.0 | 157,000 | 16.3 | 27.6 |
| CDP II | 694,000 | | 144,000 | 17.0 | 179,000 | 24.3 | 187,000 | 4.5 | 52.0 |
| CDP III | 694,000 | | 180,000 | 46.3 | 203,000 | 12.8 | 267,000 | 31.5 | 117.0 |

* Big Horn, Custer, Musselshell, Powder River, Rosebud, Treasure, Yellowstone Counties.

SOURCE: *Effects of Coal Development in the Northern Great Plains*, Northern Great Plains Resource Program, April 1975.

## TABLE VI-2

### Population Projections for Selected Communities CDPs I, II, III — 1980, 1985, 2000

| Town | CDP | 1970 | 1980 | % Chg. 70-80 | 1985 | % Chg. 80-85 | 2000 | % Chg. 1985-2000 | % Chg. 1970-2000 |
|---|---|---|---|---|---|---|---|---|---|
| Hardin | I | 3,000 | 3,000 | 0.0 | 3,000 | 0.0 | 3,000 | 0.0 | 0.0 |
| | II | | 3,000 | 0.0 | 3,000 | 0.0 | 8,000 | 166.0 | 166.0 |
| | III | | 3,000 | 0.0 | 8,000 | 166.0 | 23,000 | 187.0 | 666.0 |
| Forsyth | I | 2,000 | 3,000 | 50.0 | 3,000 | 0.0 | 3,000 | 0.0 | 50.0 |
| | II | | 3,000 | 50.0 | 4,000 | 33.0 | 4,000 | 0.0 | 100.0 |
| | III | | 4,000 | 100.0 | 5,000 | 25.0 | 6,000 | 20.0 | 200.0 |
| Colstrip | I | 400 | 3,000 | 650.0 | 3,000 | 0.0 | 3,000 | 0.0 | 650.0 |
| | II | | 3,000 | 650.0 | 6,000 | 100.0 | 6,000 | 0.0 | 1,400.0 |
| | III | | 6,000 | 1,400.0 | 10,000 | 66.0 | 13,000 | 30.0 | 3,150.0 |
| Lame Deer | I | 1,000 | 1,000 | 0.0 | 1,000 | 0.0 | 1,000 | 0.0 | 0.0 |
| | II | | 1,000 | 0.0 | 1,000 | 0.0 | 1,000 | 0.0 | 0.0 |
| | III | | 1,000 | 0.0 | 6,000 | 600.0 | 6,000 | 600.0 | 600.0 |

**SOURCE:** *Draft, Northern Great Plains Resource Program Report,* 1974, Page V-13.

Table VI-4 indicates the population projections for three-county and seven-county impact areas in Montana. These projections were prepared by the Bureau of Business and Economic Research (BBER) using different coal development assumptions. The BBER development assumptions are shown in Table VI-3.

## TABLE VI-3

### Bureau of Business and Economic Research Development Assumptions

| Montana | Alternative I (no gasification) | | Alternative II (with gasification) | |
|---|---|---|---|---|
| | 1980 | 1985 | 1980 | 1985 |
| Coal Production (million tons per year) | 49 | 61 | 57 | 77 |
| Additional Electrical Generation (Megawatts) | 2,060 | 3,060 | 2,060 | 3,060 |
| Gasification (250 million standard cubic feet per day) | 0 | 0 | 1 | 2 |

**SOURCE:** Polzin, Paul, *Water Use and Coal Development in Eastern Montana,* Bureau of Business and Economic Research, University of Montana, Missoula, Montana, November 1974.

## TABLE VI-4

### Population and Net Migration in the Economic Impact Areas With and Without Coal Development 1970 and Projected 1980 and 1985

| Population | 1970 | Projected 1980 | % Chg. 70-80 | Projected 1985 | % Chg. 80-85 | % Chg. 70-85 |
|---|---|---|---|---|---|---|
| Three-county impact area [A] | | | | | | |
| With no coal development | 18,951 | NA | | NA | | |
| With coal development | | | | | | |
| Alternative I—no gasification | 18,951 | 23,650 | 24.8 | 25,100 | 6.1 | 32.4 |
| Alternative II—with gasification | 18,951 | 26,150 | 38.0 | 30,350 | 16.1 | 60.0 |
| Seven-county impact area [B] | | | | | | |
| With no coal development | 123,295 | 129,600 | 5.0 | 132,800 | 2.5 | 7.7 |
| With coal development | | | | | | |
| Alternative I—no gasification | 123,295 | 135,150 | 9.6 | 143,150 | 5.9 | 16.1 |
| Alternative II—with gasification | 123,295 | 139,700 | 13.3 | 152,550 | 9.2 | 23.7 |

[A] Big Horn, Powder River and Rosebud Counties.
[B] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure and Yellowstone Counties.

NA denotes "not available".

| Net Migration [C] | 1960-1970 | Projected 1970-1980 | % Chg. 70-80 | Projected 1980-1985 | % Chg. 80-85 | % Chg. 70-85 |
|---|---|---|---|---|---|---|
| Three-county impact area [A] | | | | | | |
| With no coal development | -2,528 | NA | | NA | | |
| With coal development | | | | | | |
| Alternative I—no gasification | -2,528 | 2,070 | | - 568 | | |
| Alternative II—with gasification | -2,528 | 4,539 | | 1,829 | | |
| Seven-county impact area [B] | | | | | | |
| With no coal development | -8,182 | -8,103 | | -5,313 | | |
| With coal development | | | | | | |
| Alternative I—no gasification | -8,182 | -2,720 | | -1,216 | | |
| Alternative II—with gasification | -8,182 | 1,789 | | 3,072 | | |

[C] A negative figure denotes net outmigration from the area.

**SOURCE:** *Water Use and Coal Development in Eastern Montana*, Bureau of Business and Economic Research, University of Montana, November 1974.

In Tables VI-5 and VI-6 are presented coal-related employment and earnings projections derived by the Bureau of Business and Economic Research.

**TABLE VI-5**

**Projected Employment and Earnings in the Economic Impact Area**
**Alternative I — No Gasification (1980 and 1985)**

| | Projected 1980 | | Projected 1985 | |
|---|---|---|---|---|
| **Coal-Related Industries** | **Employment** | **Earnings** [A] | **Employment** | **Earnings** [A] |
| Mining | 1,017 | $15,052,000 | 1,175 | $19,505,000 |
| Export | 820 | 12,136,000 | 915 | 15,189,000 |
| Montana residents | 685 | 10,138,000 | 790 | 13,114,000 |
| Wyoming residents | 135 | 1,998,000 | 125 | 2,075,000 |
| Electrical generation | 197 | 2,916,000 | 260 | 4,316,000 |
| Gasification | 0 | 0 | 0 | 0 |
| Electrical generating plants | 175 | 2,433,000 | 260 | 4,082,000 |
| Gasification plants | 0 | 0 | 0 | 0 |
| Railroads (unit train operations only) | | | | |
| Three-county impact area [B] | 192 | 2,996,000 | 204 | 3,590,000 |
| Seven-county impact area [C] | 480 | 7,488,000 | 510 | 8,976,000 |
| Coal-related industries total | | | | |
| Three-county impact area [B] | 1,384 | 20,481,000 | 1,639 | 27,177,000 |
| Montana residents | 1,249 | 18,483,000 | 1,514 | 25,102,000 |
| Seven-county impact area [C] | 1,672 | 24,973,000 | 1,945 | 32,563,000 |
| Montana residents | 1,537 | 22,975,000 | 1,820 | 30,488,000 |

[A] In 1970 dollars.
[B] Big Horn, Powder River and Rosebud Counties.
[C] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure and Yellowstone Counties.

**SOURCE:** *Water Use and Coal Development in Eastern Montana*, Bureau of Business and Economic Research, University of Montana, November 1974.

Table VI-6 indicates total employment in the three-county and seven-county coal development impact areas in Montana as projected by the BBER.

**TABLE VI-6**

**Total Employment in the Economic Impact Areas With and Without Coal Development 1970 and Projected 1980 and 1985**

| | 1970 | Projected 1980 | Projected 1985 |
|---|---|---|---|
| Three-county impact area [A] | | | |
| With no coal development | 7,500 | 7,500 | 7,600 |
| With coal development | | | |
| Alternative I—no gasification | 7,500 | 10,029 | 10,534 |
| Alternative II—with gasification | 7,500 | 11,412 | 13,308 |
| Seven-county impact area [B] | | | |
| With no coal development | 51,700 | 51,700 | 53,100 |
| With coal development | | | |
| Alternative I—no gasification | 51,700 | 57,248 | 59,541 |
| Alternative II—with gasification | 51,700 | 59,715 | 64,338 |

[A] Big Horn, Powder River, and Rosebud Counties.

[B] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure and Yellowstone Counties.

**SOURCE:** *Water Use and Coal Development in Eastern Montana,* Bureau of Business and Economic Research, University of Montana, November 1974.

## PROJECTED HOUSING DEMANDS IN COAL DEVELOPMENT AREAS

The following material was drawn from the *Draft Northern Great Plains Resource Program Interim Report,* published September 1974.

The NGPRP has noted that housing is already in short supply in the coal development areas of the Northern Great Plains, and projects that this service will be significantly impacted as development increases. Mobile homes are expected to play a major role in meeting housing demands, particularly during the construction phases of energy installations. As development progresses, the NGPRP expects permanent housing to increase. Tremendous demands upon the local housing industry are predicted.

Table VI-7 indicates the NGPRP projected housing needs in selected Montana communities under Coal Development Profiles II and III.

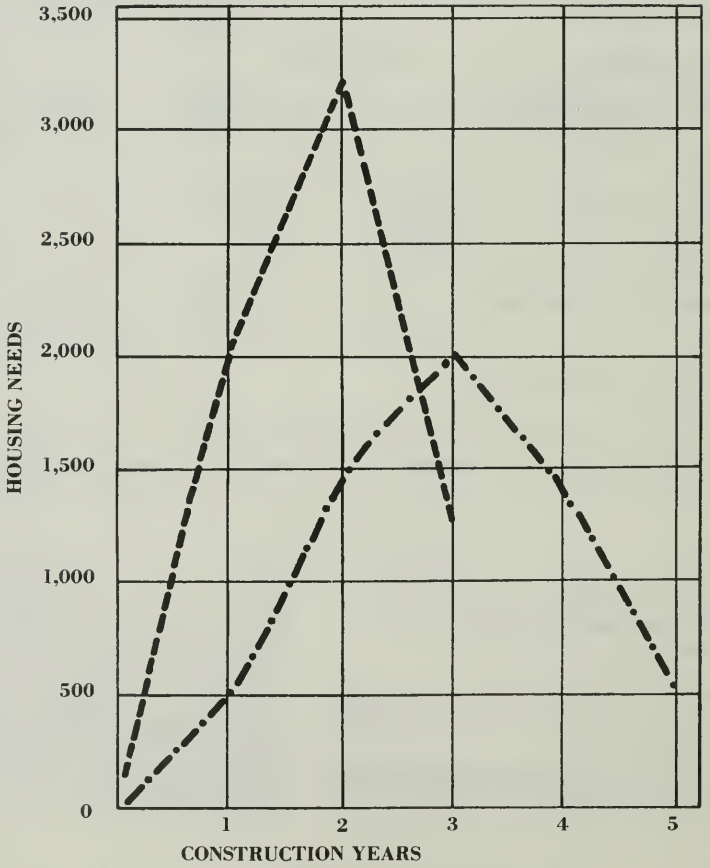
## TABLE VI-7

**Increased Housing Needs for Selected Communities—Operational Phase Development CDPs II, III—1980, 1985, 2000**

| Town | CDP | 1970 | 1980 | 1985 | 2000 |
|---|---|---|---|---|---|
| Hardin | II | 1,000 | | - | 2,000 |
| | III | - | - | 2,000 | 7,000 |
| Forsyth | II | - | - | 1,000 | - |
| | III | - | 1,000 | - | 1,000 |
| Colstrip | II | 400 | 1,000 | 1,000 | - |
| | III | - | 2,000 | 2,000 | 1,000 |
| Lame Deer | II | 500 | - | - | - |
| | III | - | - | 2,000 | |

**FIGURE VI-1: Northern Great Plains Resource Program Housing Demand Estimates**

Figure VI-1 indicates the NGPRP estimate of the housing demand that would be induced by the construction of a single gasification plant and a power plant.




**Housing requirements necessary to meet the needs of construction workers associated with a single gasification plant and powerplant.**

**SOURCE:** *Draft Northern Great Plains Resource Program Interim Report,* September 1974.

## PROJECTED SCHOOL AGE POPULATIONS RELATED TO ENERGY DEVELOPMENT

The tables on the next two pages were taken from the *Draft Northern Great Plains Resource Program Interim Report* and from *Water Use and Coal Development in Eastern Montana.*

Table VI-8 presents the NGPRP projection of the number of school age children that will accompany energy development in Montana communities under CDPs II and III.

### TABLE VI-8

**Number of School Age Children and Associated Capital Cost Required to Provide Necessary Facilities Resulting From the Operational Phase of Coal Development— Selected Communities CDPs II, III - 1980, 1985, 2000**

| City | Number of Students 1973-74 | CDP | Number of Students 1980 | Cost Millions of Dollars | Number of Students 1985 | Cost Millions of Dollars | Number of Students 2000 | Cost Millions of Dollars |
|---|---|---|---|---|---|---|---|---|
| Hardin | 1,700 | II | 130 | 0.5 | 130 | 0.5 | 1,600 | 6.4 |
| | | III | 130 | - | 1,600 | 6.4 | 6,650 | 25.7 |
| Forsyth | 660 | II | 3,000 | 11.6 | 700 | 2.6 | 700 | 2.6 |
| | | III | 700 | 2.6 | 1,000 | 3.9 | 1,300 | 5.1 |
| Colstrip | 340 | II | 1,000 | 3.9 | 1,600 | 6.4 | 1,600 | 6.4 |
| | | III | 1,600 | 6.4 | 2,900 | 11.6 | 3,900 | 15.4 |
| Lame Deer | 340 | II | - | - | - | - | - | - |
| | | III | - | - | 1,600 | 6.4 | 1,600 | 6.4 |

**SOURCE:** *Draft Northern Great Plains Resource Program Interim Report,* September 1974.

Table VI-9, taken from the Bureau of Business and Economic Research report, indicates projected school age population under the BBER development alternatives.

## TABLE VI-9

### School Age Population and Enrollment in the Economic Impact Areas Under Alternative Levels of Coal Development 1970 and Projected 1980 and 1985

| | 1970 | Projected 1980 | Projected 1985 |
|---|---|---|---|
| Population aged 0-19 years | | | |
| Three-county impact area [A] | | | |
| Alternative I—no gasification | 8,346 | 9,051 | 9,295 |
| Alternative II—with gasification | 8,346 | 9,797 | 10,940 |
| Seven-county impact area [B] | | | |
| Alternative I—no gasification | 50,205 | 48,060 | 49,872 |
| Alternative II—with gasification | 50,205 | 49,548 | 53,101 |
| School enrollment | | | |
| Three-county impact area [A] | | | |
| Alternative I—no gasification | 5,253 | 5,693 | 5,847 |
| Alternative II—with gasification | 5,253 | 6,162 | 6,881 |
| Seven-county impact area [B] | | | |
| Alternative I—no gasification | 34,958 | 33,450 | 34,711 |
| Alternative II—with gasification | 34,958 | 34,485 | 36,958 |

[A] Big Horn[ Powder River, and Rosebud Counties.

[B] Big Horn, Powder River, Rosebud, Custer, Musselshell, Treasure and Yellowstone Counties.

**SOURCE:** *Water Use and Coal Development in Eastern Montana, Bureau of Business and Economic Research, University of Montana,* November, 1974.

## EFFECTS UPON GOVERNMENT SERVICES AND LIFE STYLES IN SOUTHEASTERN MONTANA

The benefits of industrializing Eastern Montana coal reserves have been much touted. Increased revenue to state, county and local governments, more jobs at higher wages and stimulation of "sagging" economies have been presented as immediate and lasting benefits. However, attention to the costs of such development has been limited. The material presented below addresses some of those costs.

It should be noted that the absolute scale of development occurring in Montana is far smaller than that predicted in the NGPRP coal development profiles. All the impacts described below are localized, with the major impacts seldom extending beyond the county in which development is occurring.

## EFFECTS UPON GROUPS, STRUCTURES AND ORGANIZATIONS

**Uncertainty:** To date, little beyond conjecture is available to define the nature of industrial development likely to occur in Montana's coal area. State, county and local governments must not only determine what demands growth will impose upon them but must also devise plans to meet those demands, assuming large-scale energy development is to occur. These tasks are very difficult in rural areas traditionally opposed to planning. They are doubly difficult when local government units are forced to plan without the benefit of knowing federal, state and industry policies and intentions.

Local governments will have to rely heavily upon guesswork until state government defines acceptable development, and the federal government decides how much self-determination it will allow in development matters. Guesswork in this regard can be expensive. To overestimate demand is to commit government to investment in programs and facilities that will be under-utilized at taxpayers' expense. To underestimate demand is to ensure that legitimate needs will not be met. Further, various government units are uncertain of their jurisdiction in meeting development problems. Government units are justifiably reluctant to tackle expensive problems that may be another unit's responsibility.

These problems are affecting all levels of government in the coal development area in Montana, especially in Rosebud County. Staggering demands are being made on local and county government services and resources. Government bodies are experiencing difficulty in meeting those demands since they lack a clear understanding of the ultimate level those demands will reach. It is not sufficient to respond simply to immediate demand — these government structures must comprehend the ultimate service needs in order to generate appropriate, efficient and effective programs to meet both present and ultimate demands.

Similar effects are being noted in the commercial and voluntary sectors of service providers. According to Turner and McCaw (Office of Economic Opportunity, 1974), only financial institutions, and not all of them, were making plans to cope with the changes energy industrialization is expected to bring. Some local businessmen reportedly are holding up plans to expand the range of their services until such time as the limit of their potential market is known, although others have taken the risks which accompany the expansion of their operations. Fears also exist that, with larger development, chain outlets will be drawn to the area, representing competition the locals cannot meet and an outflow of profits from the local area. In addition, the housing and land markets are similarly affected. Housing and land are scarce and rents are increasing, while local interests are reluctant to go too far with investments in the event of a sudden reversal of growth.

Agriculture is affected similarly. Agricultural interests, most of which must expand to stay competitive (Gold, 1974), are marking time in an attempt to determine whether capital outlays to increase productivity will be profitable — some forms of industrialization may prove incompatible with agriculture. Those who are willing to buy or lease additional land find themselves priced out of the market. Farmers and ranchers cannot afford to compete with coal interests when bidding for land.

**Antagonism:** According to Gold (1974), formal and informal relationships established among groups, that allow them to work together to achieve local goals, have been strained. The systems that operate in the area depend upon trust and cooperation to get jobs done. This is particularly true of interaction between agricultural interests and the commercial and finance sectors. These systems have begun to break down, due to the magnitude of social change that has occurred and to different opinions of the desirability of further industrialization. Industrial interests have taken advantage of these strains. As a consequence, suspicion and distrust between groups are common. Yet, if development demands are to be met, channels of communication must be kept open.

**Demands for Services:** Detailed data on government expenditures to meet increased demand for services are being tallied. Applications to the Montana Coal Board for impact assistance funds already total nearly $11 million. More applications are expected. The Coal Board, to date, has but $2.6 million available to meet those requests. The total revenues expected for the biennium equal $11.6 million.

Discussions with local and county officials reveal a bleak picture, particularly in Rosebud County. The potable water supply system of Forsyth has been strained to its limits as has the sewage disposal system. Any increase in the capacity of the Forsyth water and sewage systems is apt to come at local taxpayers' expense, although some federal assistance may be available. County officials also have reported that planning efforts related to land use in the area are making little headway. This, in part, is due to limited financial reserves for support of a planning staff and lack of consensus concerning what the planning mandate should

[23]Grant monies to hire a full-time sanitarian recently have become available to Rosebud County.

be. Practically all land in the Forsyth area that is available for siting of mobile homes is being used for that purpose. The part-time county sanitarian[23] (he is shared with two other counties) has predicted that serious public health problems may arise in the very near future.

Rosebud County has only one public health nurse. This nurse is unable to perform all the services she would like to provide — she is barely able to keep up with her responsibilities with school children. The Department of Health and Environmental Sciences has been providing some additional aid, such as family planning services, on an intermittent basis. In addition, a $175,000 grant to build local health services in rural Eastern Montana has been awarded to the Department of Health and Environmental Sciences by the Old West Regional Commission.

Although the Rosebud County service area has numerically adequate hospital and long-term care facilities, these are located in Forsyth, 35 miles from the Colstrip construction and mining site. The only health care facilities available in Colstrip are two mobile homes: One located on the construction site and the other closer to the housing area in Colstrip. These mobile units, provided by the Montana Power Company and its construction affiliates, are staffed by nurses and serve as first aid stations and elementary diagnostic and referral centers. However, the Rosebud public health nurse and Department of Health and Environmental Sciences personnel are unable to use these units when health programs are brought to Colstrip.

Rosebud County, like so many other rural Montana counties, has a shortage of health manpower and has lost all but one of its physicians. Those that serve the area were overworked before industrialization began.

The school system in Rosebud County, especially at Colstrip, has been noticeably affected by industrialization. While some of the space problems have been solved through a Montana Power Company donation of mobile homes, to be used as classrooms, classes still are very large. Several courses have been dropped as luxury items, as the teaching staff struggles to meet increased demands. Many complain that the quality of education offered by the Colstrip school has declined. Newcomers to the area also complain about the lack of certain courses.

Recreational opportunities in the Colstrip area were very limited. Fortunately, a recreation center recently was completed and a recreation director hired. According to Colstrip hearing testimony, further recreational facilities are being planned for the community but their fate is yet uncertain. Some commercial facilities in Colstrip still are lacking — one cannot get a haircut or an oil change in Colstrip.

Crime in Rosebud County has skyrocketed. In 1972, total felony and misdemeanor arrests totaled 129 arrests (7 felonies, 122 misdemeanors); in 1973 this figure rose to 835 arrests (13 felonies, 822 misdemeanors). Of the 1973 offenses known to police, more than half were larceny/theft; slightly over 15 percent were aggravated assault. In 1974, some 200 index felonies were known to police. Index felonies are crimes for which the FBI collects data and include murder, rape, robbery, larceny/theft, assault, auto theft and manslaughter.

Finally, Rosebud County roads in the vicinity of industrial activity are in terrible condition. Designed to handle moderate use, they now are being used as major industrial arterials as well as receiving heavy use by the increased population of the area.

## SOME EFFECTS UPON LIFE STYLES

**Gillette Syndrome:** The term "Gillette Syndrome" was coined by a Wyoming clinical psychologist, ElDean Kohrs, and refers to a constellation of "deviant" behaviors noted in persons located in rural, western boom towns. In using this term, Kohrs often refers to the accompanying "4 D's" — drunkenness, depression, delinquency and divorce. Crowded and unsanitary living conditions, lack of basic community services, lack of recreational outlets, lack of community identity, lack of permanence and long hours at what may be an unrewarding task all contribute to the development of the Gillette Syndrome. Kohrs also notes that suicide attempts are frequent. He also indicates that school dropout rates and truancy are high, delinquency is common and criminal facilities are overtaxed. *(e.g.,* see Kohrs, 1974, *Social Consequences of Boom Growth in Wyoming).*

Some of the characteristics of the boom towns Kohrs discusses are beginning to appear in the Colstrip area.

**Anomie and Uncertainty:** Gold has observed a growth in anomie among residents of the Colstrip area, whether locals or newcomers. "Anomie" refers to feelings of futility, despair, rulelessness and powerlessness arising from sweeping social changes over which those concerned have little or no control and which they consider to be essentially oppressive.

Living and working conditions in many rural development areas make lasting ties between individuals difficult. The sense of impermanence in such areas ("... the whole town is on wheels — I expect to wake up some day and see half of it gone." Quote from Gold, 1974) makes such relationships impractical. Some development towns, such as Colstrip, are company owned. In Colstrip, the construction community is segregated into "manual" and "non-manual" sectors. The residents of company towns often have little control or involvement in the conduct of community affairs. As a consequence, there is little for people to do in their off-hours. Gold reports that many housewives in the construction area have become food and television addicts. A summer recreation program promises to alleviate this situation.

Locals have found many of their former ties to the old community ruptured by the newcomers. This, combined with the antagonism and resultant mutual avoidance that have come to characterize relationships between those holding divergent views on development, has served only to increase feelings of isolation. Many locals report feeling that Colstrip is no longer their town and that they are strangers in the area in which they have spent their entire lives.

The isolation experienced by ranchers and other agricultural operators in the area has served to increase their feelings of uncertainty about the future. Those living in the area have felt that, except for the vagaries of nature, they are largely in control of the direction of their lives. With massive coal development on the horizon, and no specific information as to what to expect from the companies, the state and the federal government, this certainty has been lost. Instead, hesitancy, resignation and, in some cases, fear, are becoming the rule. In this atmosphere, rumor and suspicion become guiding factors in behavior. According to Gold, many persons in the development area are making decisions about their lives without adequate information or ways of determining what is "really" going on. And, in this respect, the necessary characteristics of social interaction — trust, a sense of cooperation and responsibility — are becoming less common.

Landowners report a contempt for property rights on the part of newcomers. Trespass, open gates, destruction of property, hazing of cattle and so on, have become epidemic. Many complain of shady tactics on the part of land speculators and mining interests. Some take advantage of the size of some ranches to illegally survey or sample underlying coal seams on the chance that they won't get caught. Lies and deception are reported to be common practices of land speculators and mining interests in their attempts to put together sizeable leases. Other ranchers have reported harassment concerning continued leasing of certain nonfederal land when they oppose coal development.

Other specific effects of growth in the area are being felt. People, town folk and ranchers alike, now report feeling it necessary to lock up their possessions for the first time in their lives. Women say they are reluctant to go places alone, for the first time in their lives. Many local families report avoiding bars and other local gathering places because they are now potential objects of abuse and, in some cases, provoked fights. Many residents state that much of the joy of their lives has been lost, to be replaced by hostility, suspicion of former acquaintances and friends, and a sense of having to fight everyone for survival. Some mention how they have been forced to lower their standards of what constitutes a quality life style, and then wonder how much more social impact will be tolerable.

Finally, many have displayed awareness of the problems that affect other states and, sympathetic as they are, do not wish to see them duplicated in rural Montana. They justifiably fear a massive influx of "outsiders", for what they value most about Montana seldom seems held in high esteem by those newcomers. The energy, materials and foods crises afflicting the nation are attributed to wastefulness by many in the coal area. These people feel that the only realistic solution to those crises is a change in a wasteful life style, not simply a new rush to resource exploitation. Holding that conviction, Montanans do not wish to see their cherished state sacrificed only to postpone, for a short time, the nation's inevitable day of decision.

## SOME ENVIRONMENTAL EFFECTS OF ENERGY DEVELOPMENT

The number of anticipated environmental effects of energy development is large. Complete documentation of these effects in Montana will require more data collection and field experience. Most effects are anticipated on the basis of experience in other parts of the country. The remainder of this chapter is devoted to a general discussion of those effects.

**Loss of Diverse Native Plant Communities:** Strip mining and the construction of energy conversion facilities will destroy rangeland. If reclamation methods prove successful, some mined lands may be reclaimed. Lands converted to energy conversion sites will not be reclaimed.

Native plant species are important because they comprise the most productive and resilient range plant communities. These species have evolved to fit the severe requirements of existence within the Northern Great Plains niche. They can thrive and produce without extensive irrigation and fertilization. Wildlife and livestock are dependent upon these native plant communities for forage and cover. Introduced plant species seldom can duplicate the characteristics of native species; they may produce more luxuriant forage, but they also require a larger investment of water and fertilizer.

Because of their specialization, some native plant species and communities are very susceptible to "unnatural" interventions such as changes in soil constituents, permeability and moisture — interventions that strip mining will impose. The Northern Great Plains Resource Program has estimated that, under optimum conditions, it will require ten years to restore rangeland and 25 years to restore wildlife habitat.[24] This schedule requires seed, as well as time. There is some concern that inadequate supplies of native plant seeds are available to support large-scale reclamation efforts. The National Academy of Sciences has cautioned that reclamation may not be possible in some arid and semi-arid regions.

**Groundwater Effects:** Agricultural operators and wildlife populations in Eastern Montana rely upon shallow aquifers. In some coal beds, the major aquifer may be a coal seam slated for mining. In other areas, coal seams may be overlain by aquifers. Removal of coal seams will disrupt these aquifers. Depending upon the location of the mine site, mining may deplete water supplies used for sub-irrigation and for watering of livestock and wildlife. Ranch operators near the Decker mine have noted significant drawdowns in shallow wells. Reclamation efforts **may** restore groundwater flows. In other cases, the groundwater may be lost to the local area.

Shallow groundwaters also may be polluted by mining activities. Some overburden materials contain soluble

[24] *Effects of Coal Development in the Northern Great Plains*, Northern Great Plains Resource Program, April 1975.

minerals. If overburden replacement juxtaposes spoils containing such materials with aquifers, "downdip" groundwater quality will deteriorate. Even if this problem can be avoided, mining may result in the mixing of high quality groundwater with lower quality water from other aquifers. In either case, groundwaters may become so mineralized that they become useless for watering or irrigation purposes.

**Surface Water Effects:** Surface waters will be affected by energy resource development in several ways. First, some energy activities will require diversion of surface waters for process purposes at regular intervals. Some industrial uses of water are consumptive—diverted waters will not be returned to the stream. Second, pollution of surface waters could result from increased sedimentation from erosion of spoils, introduction of soluble minerals either from runoff, spoils seepage or groundwater, and from fallout of airborne pollutants from energy facilities or mines. Third, upsets in the thermal balance of streams may result from diversion of waters at particular periods. Increased populations also will impose additional demands upon surface waters, for recreation and for municipal purposes.

**Air Pollution:** Federal publications on energy development alternatives and reports from scientists[25] indicate that pollution control equipment can reduce the amount of some emissions, although it cannot eliminate pollutants entirely. Some conversion processes produce carcinogenic compounds or by-products. Most coal conversion processes will emit harmful gases, toxic materials and particulates in large quantities. Montana coals contain harmful trace elements. Combustion of coal will produce oxides of nitrogen, sulfur dioxide and particulate emissions which will contain trace elements within fly ash.

Studies conducted by the Environmental Protection Agency, Dr. Clarence Gordon of the University of Montana, and other scientists have indicated that oxides of sulfur and nitrogen are harmful to humans, wildlife and plants. Dr. Gordon and others maintain that damage to certain plant species (including Ponderosa Pine, the dominant timber species in Eastern Montana) will occur even when air quality standards are met. If many energy conversion facilities are sited in Montana, serious cumulative air pollution problems are expected to occur.

Fallout of airborne effluents can contaminate streams, the soil and plant communities. Studies available from the Western Montana Scientists Committee on Public Information[26] Library indicate that some effluents are incorporated by plant tissues, to the detriment of certain plant species. Other studies indicate that ingestion of such contaminated plants can damage livestock, wildlife and humans.

The specific effects of the operation of the Colstrip thermal plants have not been determined. Data collected on the Corette plant in Billings, which burns Colstrip coal, indicates that air quality standards often were violated by that plant. Gordon has noted $SO_2$ and fluoride-induced damage of Ponderosa Pine in the Billings area.

Contamination of plant communities, water and soil by airborne effluents poses threats to agriculture, wildlife and human health.

**Noise:** Noise has been shown to have harmful emotional and physiological effects upon humans. Noise from blasting and plant "blow downs" at Colstrip are reported to have disturbed residents of the Colstrip area. Teachers have reported that their classes have been disrupted by blasting operations at the Western Energy mine. Ranchers have claimed that blasting operations at strip mines have disturbed their livestock to the point of stampedes. Noise also may disturb wildlife populations to the extent that they migrate from the area.

**Wildlife Populations:** Destruction of wildlife habitat can only result in decreased wildlife populations. Some aquatic species are quite susceptible to changes in water quality, flows and temperatures. Change or deterioration of this habitat usually leads to their replacement by less desirable species. Animal species rely on specific foods at specific times of year. They also require remote or special areas for breeding. Winter range requirements are critical to species survival.

Energy development will directly affect critical dimensions of wildlife habitat. Food species and other requirements of wildlife populations will be reduced or eliminated — sometimes permanently. Increased human populations will occupy niches formerly occupied by wildlife. Recreational activities also will increase pressures upon wildlife species. The Northern Great Plains Resource Program has indicated that coal development will result in reduced wildlife populations.[27]

**Land Use:** Many changes in land use will result from energy development. Rangeland and wildlife habitat will be used for mine sites, conversion plants and associated facilities, home sites, municipal and commercial sites, transportation arteries and so on. A further impact is the ownership of large tracts of land by remote industrial interests. Assuming that reclamation does prove successful, large areas of potential agricultural, range and wildlife lands may be retained by corporate entities. It must be determined to what use such corporate lands will be put. Some provision should be made to ensure that successfully reclaimed lands are put back into appropriate uses.

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[25]Synfuels Task Force Reports; *A Western Regional Energy Development Study*, Radian Corporation, August 1975; Testimony of C. C. Gordon before the Department of Natural Resources and Conservation hearings on Colstrip Units III and IV, March 1976.

[26]Western Montana Scientists Committee on Public Information, University of Montana, Missoula, Montana.

[27]*Effects of Coal Development in the Northern Great Plains*, Northern Great Plains Resource Program, April 1975.

# VII. SOME QUESTIONS

Many vital questions regarding energy development remain unaddressed. This chapter is devoted to a brief discussion of some of those questions, in hopes of stimulating public consideration of them.

## RESOURCE ALLOCATION

The nation and Montana clearly face an energy crisis. Until an acceptable solution to the energy crisis is found, coal reserves will be developed to provide an interim source of supply. To the degree that national survival is tied to massive development of fossil fuel reserves, Montana must expect to provide significant quantities of them. However, increasing numbers of citizens and scientists are coming to recognize that true national survival is more apt to be achieved through pursuit of some alternative to the concept of infinite growth in resource consumption. Until a rational decision is made at the national level defining the course to be pursued, careful and conservative allocation of remaining resources is a sensible approach.

Industry and government discussions of coal often portray it as practically inexhaustible and only as a source of energy. Both conceptions are erroneous. Dr. Jerry Plunkett has given the author data indicating that recoverable coal reserves within 3,000 feet of the surface could be exhausted in less than 70 years, if coal is used as the nation's primary source of fuel. Dr. Plunkett adds that mining all coal to a depth of 6,000 feet would change his estimates only five to ten percent.[28] Coal also represents the largest remaining potential source of the organic compounds that sustain the synthetics, pharmaceutical, fertilizer and other petrochemical industries. Even assuming that some miracle of technology does eventually solve the nation's energy crisis, the petrochemical industries still will require a feedstock resource. It would be foolish in the extreme to deplete a critical nonrenewable resource at its lowest level of use when other alternatives are available. This is particularly the case when, while energy needs may be met with other alternatives (see Chapter V), no known, feasible feedstock alternatives are available to the petrochemical industries once fossil fuel reserves are depleted.

The impact of coal allocation decisions upon the allocation of other resources, renewable and nonrenewable, cannot be ignored. Decisions to develop coal on a large scale will have obvious effects upon the demand for land, air, water and construction materials. Those decisions also will increase the pressure upon such resources as open space, wilderness, wildlife species and other recreational resources. Finally, resource allocation decisions will impose significant demands upon human resources, ranging from public institutions to social relationships and individuals. Some of the resources to be affected are renewable, others are not — including small, rural agricultural communities.

The public and their elected representatives must define the optimum use of the nation's remaining energy reserves before an irrevocable decision is made concerning their use. Classic marketing principles are apt to provide no acceptable answer to that question, unless the needs of future generations are to be ignored. In reaching a definition, careful attention must be paid to alternatives to wholesale development and to the known and likely costs associated with each. The public and their officials should recognize that any allocation decision will entail resource losses, many of which will be permanent. If the decision is to be responsible and equitable, it must be reached with full recognition and consideration of those losses. The nation must ask itself if Montana and other relatively unspoiled rural areas are to be perceived of value only insofar as they are underlain by energy and other material resources. It is possible that the optimum use of substantial portions of the nation's coal reserves will entail leaving them in the ground, in light of worldwide food, material and energy scarcities.

## THE MONTANA LIFE STYLE

Much has been made of the Montana life style in discussions of energy development. Although few seem willing to define the term, most seem to understand it. To the degree that the Montana life style is dependent upon a rural atmosphere, open spaces, enjoyment of and an acknowledged dependence upon the natural environment, and a relatively unhurried way of doing things, energy development will affect it. Small-scale energy industrialization likely can be accommodated by the Montana life style. It is difficult to imagine that extensive energy development and attendant urbanization will not conflict with it.

Maintenance of the Montana life style has imposed some costs. The state has relatively high and cyclical levels of unemployment. Outmigration of young people is common, particularly in rural areas, although this phenomenon is by no means unique to Montana or to rural areas.[29] Per capita income levels are lower in Montana than in many other states. Public services and programs are harder to find in Montana than in more urbanized states. It should be determined to what degree these costs are a necessary condition of the Montana life style and to what degree Montanans are concerned with them.

Some attempts should be made to clarify two questions, if concern for their life style is to play some role in the decisions Montanans make regarding energy development. First, some definition of the compatibility of various forms

[28] Personal communications with Dr. Jerry Plunkett, Director, Montana Energy and MHD Research and Development Institute, January 1976.

[29] *Population Mobility Trends in the Upper Midwest*, Upper Midwest Council, Minneapolis, Minnesota, 1975.

of energy industrialization and the Montana life style must be derived. Second, Montanans must decide to what degree, if any, they are willing to preserve or forego their life style in the face of energy development. Until the public and their elected representatives have reached some conclusion in this regard, resolution of the question of the future of our life style cannot be sensibly approached. The States of Washington and Idaho[30] recently have conducted programs to assess the degree to which their citizens wish to pursue economic growth, industrialization and so on. The results are interesting; the citizens of both states demonstrated a cautious attitude toward rapid economic growth and especially toward polluting industrial activities. A similar program in Montana could initiate the public discussion necessary to resolve this issue.

## THE ROLE OF THE PUBLIC IN DETERMINING MONTANA ENERGY POLICY

The current administration has indicated its desire to stimulate and support greater public involvement in government. Few issues of state concern are more in need of public involvement than is the energy issue. No formal existing government mechanisms seem appropriate to the task of eliciting and responding to public input in the energy policy process, although some might serve if modified and expanded. Some specific organization or structure may be necessary to provide sufficient funds and staff time to support public participation in energy policy development.

It will be necessary to define what role the public desires in developing policy and what function government and the public can negotiate for that participation. At present, formal public participation in government affairs is limited largely to review of government suggestions. Participation in energy policy development ideally would go beyond simple review and comment. Public participation should be as thorough as possible since an energy policy, if developed, will play a significant role in determining the state's future. Such participation would include discussions at frequent public meetings, careful analyses of government prepared materials and preparation of alternative positions by both the public and government. It also would include a significant attempt at concentrated public information and education by both the public and government.

Past government attempts at achieving intensive public participation in government matters have not been very successful. This may be due to the limited role offered the public — it also may be due to lack of public interest. If state government and the public wish to pursue greater public participation in energy policy development, the first step must be that of determining the extent of public interest. Doubtless, public interest groups on both sides of the issue wish to become involved — the trick is to learn how many of the "neutral" members of the public are interested. Government and some public advisory body (to include persons with experience in successful public involvement) should immediately outline alternative programs for public involvement with the roles and responsibilities of both public members and government clearly stated, if sufficient public interest exists. These alternatives should be presented to the public and a program satisfactory to both groups should be developed. For its part, government should commit adequate manpower and financial resources to any agreed upon public involvement program, as soon as that program is defined. Any public program of this sort will fail without staff and dollar support.

[30]Alternative Futures for Washington and Idaho Tomorrow projects.

## THE ROLE OF STATE GOVERNMENT IN DETERMINING ENERGY DEVELOPMENT

State government can play a strong role in determining energy development within its bounds. The Montana Constitution, numerous statutes and policies pose limits to the form, scope, methods and location of energy development within the state. Explicit and implicit limits and issues that must be considered by state government and industry in reaching energy development decisions are contained within these documents. In addition, Montana laws on taxation and the funding of government services influence development decisions. Montana government has enforced its laws and policies with the assumption that they apply to all energy development activities conducted within the bounds of the state. Only those activities on Indian reservations and those where federal statute explicitly abrogates state responsibility are excluded from state purview.

Several Montana statutes and policies recently have come under fire from spokesmen for some midwestern states, the federal government and industry. These attacks have centered around the contention that Montana's taxation laws are unreasonable and that other statutes pose unnecessary delays and limits on various forms of energy development. Some industrial spokesmen have publicly called for congressional revocation of Montana law. Some federal bills have contained language that would enable the federal government to override state laws regarding the siting and regulation of utilities.

It is important that Montana government become prepared to meet any attempts at abrogating its constitutional and statutory responsibilities. Research should be initiated to determine legal precedents for resolution of conflicts between federal and state law, and between state constitutions and federal law. Some investigation of the recourse available to states in conflict with the federal government also should be initiated.

A more complete discussion of the steps Montana should take regarding energy development law and policy, assuming no federal preemption, is presented in Chapter VIII, *A Montana Alternative.*

## THE NATURE AND DURATION OF ENERGY RESOURCE DEVELOPMENT

Montanans probably will play only a small role in the nation's choice of a resource allocation alternative.

However, once the decision has been made and Montana-based resources are slated for development, Montana law and policy should play a significant role in shaping the nature and duration of development within the state's bounds. Montanans must consider several issues in order to meet this role in resource development. The issue of the nature and duration of energy development that may be beneficial to and tolerated by Montana is an important one.

Montana history provides ample testimony to the tragedy of "boom and bust" economies.[31] Although some economists state that the likelihood of a coal "boom and bust" is small, others disagree. The coal reserves in Montana probably will remain marketable for quite some time, as the number of uses for coal increases and competing fossil fuels near exhaustion. However, the fates of various coal development alternatives are not as certain. The possibilities of a coal "bust" probably can be minimized if coal development in Montana is limited to well planned, carefully dispersed mining and very selective conversion activities. If coal development is geared to the wishes of coal producers and to commercially untested technologies, the basis for a coal "bust" may be well laid. This latter possibility cannot be ruled out until such time as the public can be assured that federal support will not be given to the promotion of hypothetical markets and untested technologies, as exemplified by the Synthetic Fuels Commercialization Program at the federal level. Further, in a period when energy conversion technologies and related research are in a state of flux, it could be dangerous to commit the state's future to energy development activities and technologies that may be replaced in the near future. For that matter, some industrial and federal spokesmen have begun to indicate an awareness that load center conversion of fossil fuels may be preferable to mine mouth conversion.

Much attention has been given to the possibility of growth of heavy industry in Montana, based upon the development of suprlus "cheap" energy derived from coal. This issue has been discussed to some degree in Chapter IV. Suffice it to say that energy from coal is going to be comparatively expensive even from coal-fired thermal electric plants, and quite expensive from synfuels technology. The price of such energy and Montana's distance from major markets of most commodities should work against such derivative industrial growth. This would appear to be particularly the case when investment capital is hard to find.

Unemployment is high in Montana. Energy development will provide some jobs. However, the number of such jobs is limited in relation to the size of the capital investment required for energy development. Judging from the Colstrip I & II experience and from federal publications, the majority of jobs created by energy conversion activities will require highly skilled, specialized labor. At Colstrip, the investors were obliged to import laborers from other states and from Canada to fill all available jobs. Most unemployed persons in Montana are seasonal and semi-skilled workers, though some skilled laborers also are now unemployed.[32]

Unemployed Montanans may not qualify for many of the direct employment opportunities that energy development will provide. Further, the centers of highest unemployment in Montana are in the western portions of the state — energy development is slated for Eastern Montana. A study conducted in preparation of the Colstrip Environmental Impact Statement has indicated that more permanent jobs will result from the mining and export of Montana coal than from operation of Colstrip Units III and IV.[33] The major, long-term job impact of energy development activities may be an expansion in secondary service industries. These industries pay low wages, as researchers at the Bureau of Business and Economic Research are quick to point out.[34]

Although Montanans should not regard energy development as a panacea to unemployment and low per capita incomes, some development activities could strengthen other economic sectors. For example, Raymond Gold[35] has suggested that some forms of energy development will benefit agriculture. Gold maintains that carefully sited and limited energy development activities may provide the added income necessary to those Montanans who wish to remain in agriculture but require supplemental incomes in order to do so.

The matter of compatibility between economic activities also bears some examination. No definitive data have been collected regarding the specific degree of compatibility between agriculture (Montana's primary basic industry) and energy industrialization. Studies conducted by various groups responsible for environmental impact statements do permit some inferences, however. Energy industrialization on a massive scale places severe strains upon community relationships and community services when sited in rural areas. Researchers have predicted significant impacts upon air quality and water quantity and quality. Extensive damage to plant species has been predicted even where air quality standards are met (see Chapter VI). The change of rural communities to more urbanized ones will increase

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[31]K. Ross Toole, *Twentieth Century Montana: A State of Extremes*, University of Oklahoma Press, Norman, Oklahoma, 1972. See also Toole's testimony before the Board of Natural Resources and Conservation Hearing on Colstrip Units III & IV, March 1976.

[32]Personal communications with Curt Warner, Employment Services Bureau, Montana Department of Labor and Industry, March 1976.

[33]Schail, Malinda, study completed for the Department of Natural Resources and Conservation, Environmental Impact Statement on Colstrip Units III & IV, January 1975.

[34]Publications of and personal communications with the Bureau of Business and Economic Research, University of Montana, Missoula, including the *Montana Economic Study*, December 1970; *Water Use and Coal Development in Eastern Montana*, November 1974; portions of the *Decker Environmental Impact Statement*, Department of State Lands; and Paul Polzin's testimony at Colstrip III and IV hearings, March 1976.

[35]Personal communications with Raymond Gold, Institute for Social Research, University of Montana, Missoula, December 1975.

pressure on the finite land and resource base. Montana agriculture is dependent upon open space, clean air, ample and clean water and, according to Gold,[36] upon certain social relationships. The loss of any one of these resources could lessen the viability of agriculture in development areas. Although, as economic studies have indicated, the dollar value of agricultural productivity cannot compete with that of coal for given land areas, agriculture is based upon renewable resources — coal development is not.

Other economic activities dependent upon outdoor resources may be threatened by energy development. With reclamation potential still uncertain, it is difficult to imagine mine spoils as conducive to the recreation and tourism industry or to such outdoor pursuits as hunting, hiking, camping and photography. Similar comments apply to smokestacks and plumes. It is possible that pursuit of the much sought goal of economic diversity for Montana may be hindered under some forms of energy industrialization. For this reason, the question of the compatibility of various energy development alternatives with other existing economic activities in Montana should be answered. If energy development should reduce the viability of or eliminate other economic sectors, Montana could become even more susceptible to national market cycles.

It is important that Montanans keep such possible incompatibilities in mind when considering the type and scope of energy development that may be desirable. Montanans also should be concerned that large-scale industrial development may shift the center of political influence within the state — Montana history is a testament to the effects of political domination by industrial interests. Some of the firms seeking to develop Montana resources have unsavory political reputations in other parts of the country. It is to be hoped that Montana can find some middle ground in which the nation's need for energy and the state's need for economic activity can be met without long-term and irreversible damage to Montana's resources. If such a middle ground cannot be found, the point to be occupied by Montanans is better chosen with understanding of the losses to be suffered and the benefits to be reaped than with reliance on the whim of fate.

[36]Gold, Raymond L., *A Comparative Case Study of the Impact of Coal Development on the Way of Life of People in the Coal Areas of Eastern Montana and Northeastern Wyoming*, Institute for Social Science Research, University of Montana, Missoula, June 1974; *How Southeastern Montanans View Coal Development*, Community Services Program, University of Montana, Missoula, October 1974; *A Study of Social Impact of Coal Development in the Decker-Birney-Ashland Area*, Community Services Program, University of Montana, Missoula, May 1975.

## VIII. A MONTANA ALTERNATIVE

The material presented in previous chapters outlined the dimensions of the energy issue in Montana. Solution of the nation's energy crisis will require an unprecedented investment of resources and an unprecedented change in the normal course of public affairs. Errors made in this process will have pervasive effects lasting for generations, perhaps forever.

This chapter outlines the author's suggestions regarding the necessity for a formal state energy policy, what that policy should address and how it can be developed. A suggested interim position regarding energy development is included.

### THE NEED FOR A STATE ENERGY POLICY

The public is both confused and concerned about the energy crisis and energy development in Montana. Many citizens apparently doubt the reality of the energy crisis. Few are aware of the limits of energy resources, the limitations of current energy production and conversion technologies and the likely impacts of energy development proposals. Fewer still appear to understand the relationship between demands for goods and services and increased pressures upon resources, energy and the ecosystem.

Public expectations must be examined and changed if the energy crisis is to be solved. Chief among these expectations is the belief that natural resources are infinite and, for this reason, that natural resource development also can be infinite. A second expectation is that all economic growth is good and more is better. Persistence in these expectations can only aggravate energy and related food and materials crises. These crises are more apt to be solved if more people realize that resources are finite and limits to growth do exist.

Acceptance of a "limits to growth" viewpoint will require much discussion on the part of everyone and significant change on the part of many. The potential for confusion in such discussions is great. Developing a state energy policy could stimulate public discussion and reduce the degree of related confusion, if an active program of public education and involvement is made a part of the process.

Confusion exists within state government in its approach to energy development. Five agencies of Montana government [37] deal directly with energy development issues, from five separate perspectives. Coordination of effort among these agencies is marginal, even at the highest levels. Some programs of these agencies overlap — some work at cross purposes. A clearly stated energy policy effectively enforced by the Executive Branch and specifically identifying state goals and state agency roles, would increase the coherency, efficiency and effectiveness of government activities.

Confusion also exists between levels of government. The lines of authority and responsibility in various areas of resource management are not yet clearly defined. No formal

[37]Department of Natural Resources and Conservation, Department of State Lands, Public Service Commission, Department of Fish and Game, Department of Health and Environmental Sciences.

federal energy policy has been prepared. The state should act to fill this void before inaction prompts eventual and undesirable federal reaction. Montana should prepare an explicit statement of its objectives regarding energy development and the specific responsibilities of state agencies regarding those objectives. A statement of this sort would reduce confusion between government levels. It also would meet the complaints of federal and industry spokesmen who are unsure of the agencies or individuals with whom they should work in energy matters.

The federal government has management responsibilities for many of the energy and mineral resources slated for development within Montana. The federal government is accountable to many disparate interests — other states, regional interests, industrial interests, and so on. Montanans cannot afford to rely upon the federal bureaucracy to develop policies that will reflect the needs of Montanans — we simply are too few. The accountability of the federal establishment to various interests by no means indicates that it is accessible to the citizens of a sparsely populated state. The wishes of a small number of people are easily ignored. The laws and policies of a state government are not so easily ignored. If Montanans wish to control the future of their state, they must ensure that the details of that future are clearly understood by those who would affect it. A policy statement and a program of statutes to implement it would meet this need.

The complexity of the energy issue is so great that some process is required to reduce it to a comprehensible problem. The process of developing a policy statement will require an incisive analysis of the energy issue. A clearly stated policy also will indicate milestones and will provide a focus for the evaluation of solutions to present and future manifestations of the energy crisis.

## THE ROLE OF STATE GOVERNMENT IN DEVELOPING ENERGY POLICY

The question of the appropriate role of state government in the energy development issue must be addressed. Traditionally, state and local governments have been perceived as having only a reactive role in the development of social, economic and natural resource policies. It has been assumed that such policies are best determined at the ballot box and in the marketplace. The validity of this assumption bears examination.

Policy development by ballot box very often becomes a "sometimes thing". Review of and input to policy decisions tend to be limited to election year intervals. Further, the vagaries of partisan politics may preclude the statement and analysis of policy issues in unmistakable terms. As a consequence, citizens are able to become well informed concerning an issue and its effects only at great expense of time, if at all. Further, the choices offered by the ballot may themselves confuse the issue, perhaps addressing it only partially or in a contradictory manner. Any issue as complex as the energy issue requires far more time in analysis and thought than the campaign season affords.

Policy-making in the marketplace considers only the fortunes of those immediately involved in the market process. Unless laws or policies demand otherwise, market decision-makers in most instances are obliged to consider only the immediate and short-term effects of their decisions upon the entity they represent. Unless all those competing in the marketplace are willing or required to consider the long-term costs of their decisions upon everyone affected, the entity that does consider those costs often operates at a competitive disadvantage. As a result, those entities with no financial "ante" in the marketplace are effectively disenfranchised in the decision-making process.

The needs of future generations seldom are represented in marketplace decisions. Most of the resources to be developed or affected by resolution of the energy crisis *(e.g.,* air, water, land, coal, social structures, wildlife) are **public** resources. Yet, as the marketplace currently is constituted, the public is not represented.

A more appropriate role of the private sector is that of defining the best way in which to accomplish given goals. In short, it is the public's responsibility to determine overall goals, including those concerning growth and resource development. It also is the public's responsibility to determine the ground rules by which those goals are to be reached. Once the goals are set and the rules established, the private sector should determine how to achieve those goals in compliance with the rules.

Some means must be found to ensure both equal representation of all parties involved in the energy issue and a rational approach to it. The energy issue is too complex to be dealt with on a cursory basis. No intelligent analysis of it can proceed without due consideration of the needs and goals of all sectors of the public. Despite its many limitations, state government **could** serve this function **if** sufficient resources were committed to the problem, and **if** the policy formulation process were made available and accountable to the public. Government is the only sizeable institution in this state whose function is specifically designed to serve the public good. Government is more accountable to the public than is the marketplace, given effective political leadership. Government also comprises a broad-based pool of professionals whose skills could be focused on the energy issue. Finally, the responsibilities of government have resulted in the development of a wide range of contact points with various sectors of the public. These resources should be used to initiate the development of a state energy policy.

## REQUIREMENTS FOR DEVELOPMENT OF AN ENERGY POLICY

Any policy development process worthy of the name will require specific delegation of authority and responsibility. It also will require focused allocation of financial and manpower resources. The energy policy issue is too critical [illegible] important to be based upon redirection of resources [illegible] effort approached in this way will receive only [illegible] priority. If energy policy development is to be [illegible] attention it deserves, some central body should [illegible] and funded to address it.

Montana government should organize a staff of competent, self-motivated individuals who together possess a broad understanding of the energy issue. In addition to staff resources, sufficient funds must be allocated to an "energy office" to meet several needs. Those funds would be used to gain active public involvement in the policy development process and to support essential contract work. Public involvement work would entail the organization of active citizen advisory groups on energy throughout the state, the preparation of educational materials, and staff work to pursue citizen recommendations. Research funds would be used to fill gaps in our understanding of the energy issue and its effects.

## WHAT A STATE ENERGY POLICY SHOULD ADDRESS

A basis for the development of a Montana energy policy is provided within the Montana Constitution and in Montana statutes. As discussed in Chapter IV, these require:

(1) The maintenance and enhancement of a clean and healthful environment for the citizens of the state;

(2) Protection of the environmental life support system;

(3) Wise use of the state's natural resources, in a manner of maximum benefit to all citizens;

(4) That the present generation serve as trustees of the state's natural resources in the interests of succeeding generations; and

(5) That state government take an active role in insuring that the ecosystem and natural resources are protected, used wisely and enhanced.

Some of the guidelines implicit in the Constitution and several energy statutes are in conflict with "traditional" resource development and laissez-faire activities. It will be necessary to clearly identify and discuss these points of conflict. Central among them are the following.

Traditional resource development policies have assumed that determinations of the extent, manner and effects of resource development are the province of the developer. Although the resources to be developed are considered to be publicly owned, it has been assumed that private capital can best determine where and how those resources are to be developed and used. Negative effects of development are assumed to be inevitable, if unfortunate, consequences of progress that must be borne by the few for the benefit of many. However, the Montana Constitution and statutes require that the public, or their representatives, determine the degree of development and the extent of negative effects that will be tolerated. The private interest sector is then to operate within the constraints set for it by the general public. Government must acknowledge that this conflict exists and respond to it. Government must accept the position of the Constitution and statutes and act accordingly. In accepting this responsibility, government must determine the context within which resource development is acceptable. The task will entail significant work with the public and the private sectors and in technical areas.

Conflict exists in another area. Constitutional and statutory guidelines indicate that the state's natural resources are to be used in the best interests of the public and of future generations. This concept is in direct conflict with laissez-faire concepts which assume that the distribution of maximum benefit is up to the success of the developer — that is, public benefit will result from the presence of a successful developer. If it can be shown that future generations or a segment of the public will be harmed by a developer's actions, then the state will be obliged to oppose the developer. Again, the Constitution and statutes provide sufficient guidelines to aid the state in defining beneficial and harmful development.

Also implicit in recent legislation is a concern for the finite nature of nonrenewable resources. The legislature has recognized that, once developed, nonrenewable resources are forever lost. That body also has recognized that future generations may require those resources for far different uses than those of the present generation. In light of this, it is illogical to deplete nonrenewable resources out of convenience, when other alternatives may be available.

Finally, current legislation specifically requires that development activities in the state are to be conducted in a manner that will preserve and enhance the value of the state's renewable resources. When it is demonstrated that some levels of coal and energy development are detrimental to the productive use of Montana's renewable resources, government will be obliged to limit that development. In this case, state government has a responsibility to determine levels of nonrenewable resource development that are consistent with legislative mandates.

The author suggests that the response of state government to constitutional and legislative energy policy guidelines address the following items:

(1) Definition of limits of acceptable energy development. This will include the identification of areas in which development should not be allowed due either to the presence of unique values or to conflicts with long-term development of renewable resources. This will require considerable research to determine the compatibility of energy development alternatives with other resource values;

(2) Determination of alternatives to large-scale development of nonrenewable resources. Such development can be encouraged only when it has been demonstrated that no alternatives exist. In such cases, development should be guided to maximize public benefit and the longevity of the resource;

(3) Development of nonrenewable resources to proceed in compatibility with renewable resource development. Public proceeds arising from nonrenewable resource development should be invested to maintain or enhance the state's renewable resources and their development;

(4) Promotion by the state of research and development of energy conversion and industrial technologies

based upon renewable resources. Such promotion could include investment of state funds (in a manner similar to that mandated by Senate Bill 86, an act creating a fund for research, development and demonstration of alternative energy sources and allocating certain revenue from coal taxes to the fund) and pursuit of federal and other funds;

(5) Conservation of energy and other resources at all levels; and

(6) Documentation of the relationships between economic and population growth and demands for resources. Results of such research should be presented to the public and their representatives in a continuing dialogue.

Any creditable discussion and analysis of the items listed on the previous page will require a concentrated effort. This effort will require several man years and considerable financial support.

Initial steps in the development of a state energy policy could include the following:

(1) A detailed determination of Montana energy reserves and of Montana energy production, distribution and consumption, by energy source and consumption sector. Historic, present and projected data would be relevant;

(2) A comprehensive analysis of the role of energy in the Montana economy, to include identification of dependencies on particular energy forms. Also to be included would be identification and analyses of possible alternatives to present levels of energy consumption, by energy form (*e.g.*, Can Montana smelters operate using coal or electricity instead of natural gas? Are more energy-efficient processes economically feasible?);

(3) Analysis of the latest information on the range of energy production, conversion and use technologies available to Montana;

(4) Development of outlines of "alternative futures" that Montana could feasibly pursue, in light of the relevant statutory and program tools available to state government. These "futures" would focus upon alternative sizes and mixes of sectors within the Montana economy. Each alternative would be supplemented with a discussion of the tradeoffs associated with it and the activities necessary to its implementation. Among the factors considered in the tradeoff analyses would be determination of the energy needs associated with each alternative and the effects of such energy needs upon the state's human and natural resource base. Particular reference would be made to the constitutional and statutory guidelines mentioned above in the analysis of each alternative;

(5) A thorough program of public involvement. If an energy policy statement is to be adequately representative of the desires of the state, and is to accomplish anything, public participation in development of that statement will be essential. Implementation of any energy policy, other than one that involves doing nothing, will entail some change and some public acceptance and support. The public will have little reason to support a policy they do not understand and to which they have had no input;

(6) A thorough analysis of state government activities. This analysis should focus on defining the appropriate roles of the departments of state government in the development and implementation of a state energy policy. To date, no material specifically addresses the matter of state programs and how they affect or are affected by energy development. An analysis of the degree to which departmental policies and programs are compatible with policy guidelines established in the Constitution and various energy-related statutes also is needed; and

(7) Development of departmental policy implementation plans. Once a policy position has been established and appropriate agency roles identified, implementation plans must be developed. In this context, any statutory and policy conflicts and gaps must be examined and rectified. Some laws may require action that is inconsistent with the energy policy and should be repealed. Other areas of concern may be left unaddressed by statute. In either case, appropriate legislative proposals should be prepared for submission to the Legislature.

## AN INTERIM ENERGY POSITION

Until such time as the issues raised above have been addressed adequately, and a comprehensive state energy policy has been developed, Montana should adopt the following interim positions:

(1) Montana recognizes the existence of limits to economic growth and resource consumption, as traditionally defined. Recognizing these limits, Montana will discourage resource consumption based upon the assumption of unlimited growth and which limits the long-term quality or use of renewable and nonrenewable resources;

(2) Montana recognizes a policy of interdependence between states and nations. Montana resources will be developed in response to legitimate national needs and in compatibility with the needs of Montanans. Rapid and large-scale development of nonrenewable resources (particularly that apt to be of short duration) will be accepted only if no alternative is available and only if such development is conducted with due consideration for and correction of related resource costs. Development costs are to be borne by the consumers of the resource. State government will act to assure that such costs are met as equitably as possible;

(3) To the degree possible, the benefits of non-

renewable resource development will be invested in the maintenance and enhancement of the state's renewable resource base;

(4) Recognizing the relationship between population density and increased demands upon resources, services and the ecosystem, Montana will not encourage development activities which will entail any rapid and large-scale influx of people. In the event that some large-scale population influx becomes inevitable, the state will direct that influx to more urban areas, in preference to rural and agricultural areas;

(5) Construction of large-scale energy conversion facilities in Montana for export of energy products to other states will not be encouraged, unless no other alternatives exist. Only if such facilities are necessary to meet identified and defined Montana energy needs, will their construction be approved.

(6) Montana government will ensure that necessary energy resources are available to all Montana energy consumption sectors, consistent with good faith conservation efforts. To this end, state government will act immediately to determine the minimum levels of energy that are necessary to ensure the health of the citizenry and the state's economy. The state also will assess the program and jurisdictional resources available to this task and act to correct deficiencies. As an additional priority, the state will investigate existing and alternative energy production technologies that will serve to meet state energy needs. This investigation will focus upon readily available coal conversion technologies and will support the development and expansion of technologies to utilize renewable energy sources (*e.g.*, solar, biomass, wind and small-scale hydroelectric potential). Further, the state will accelerate the development of energy conservation programs for both government operations and the state as a whole;

(7) Where investigations reveal the necessity of doing so, Montana government will prepare statutory proposals to cope with demands created by energy needs and energy development; and

(8) Montana state government will adhere to a position of strict and conscientious enforcement of statutes and policies relevant to energy and natural resource development. The state will oppose vigorously any attempts by the federal government or other states to weaken or negate those statutes or policies.

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